MECHANICAL ENGINEERING

March 1956

in this issue

Heavy Presses Now in Production . . . . . G. W. Motherwell 214

Progress in Railway Mechanical Engineering, 1954–1955 218

Science Changes the Scientist Tool . . . . . G. E. Doan 231

Difluorodichloromethane . . . . . S. F. Murray, R. L. Johnson, and M. A. Swikert 233

The Role of Technological Institutions in the Years Ahead . . . . . J. T. Rettaliata 237

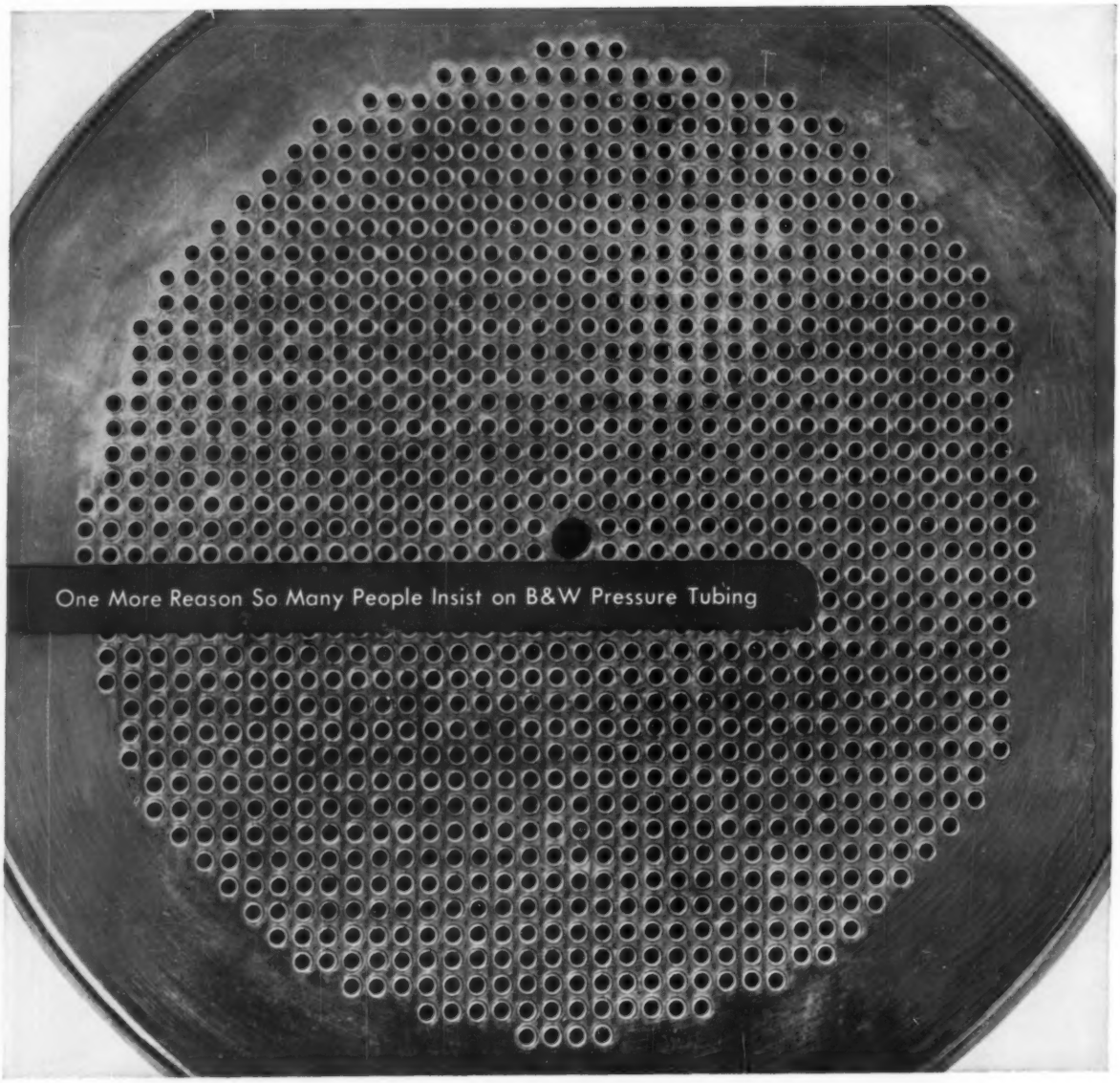
The Engineer's Greatest Achievement . . . . Crosby Field 239

How Radiographic Inspection of Lead Linings Can Reduce Future Maintenance Costs . W. Straka and V. P. Bracken 245

DEPARTMENTS

Editorial 213
Briefing the Record . . . 248
European Survey 262
ASME Technical Digest . . 265
Reviews of Books 276
ASME News 279
Keep Informed Adv. p. 41

ASME Semi-Annual Meeting • Cleveland, Ohio • June 17-21, 1956



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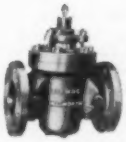

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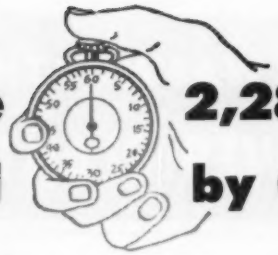

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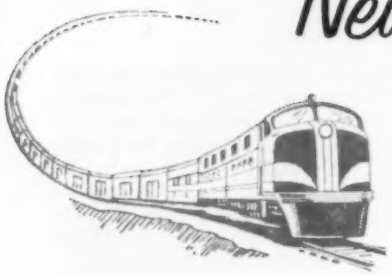

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The Model R provides constant support which is mathematically perfect for all positions of travel. This constancy of support is maintained throughout the full range of field adjustability. Needle bearings minimize friction.

Grinnell Constant-Supports are individually calibrated to support the exact load specified. All Model R Constant-Supports have a full 70 percentage points of field adjustability built into them. No less than 10% of this adjustability is allowed either side of calibration for plus or minus change in load. Field re-adjustments are easily made by turning a single load adjustment bolt.

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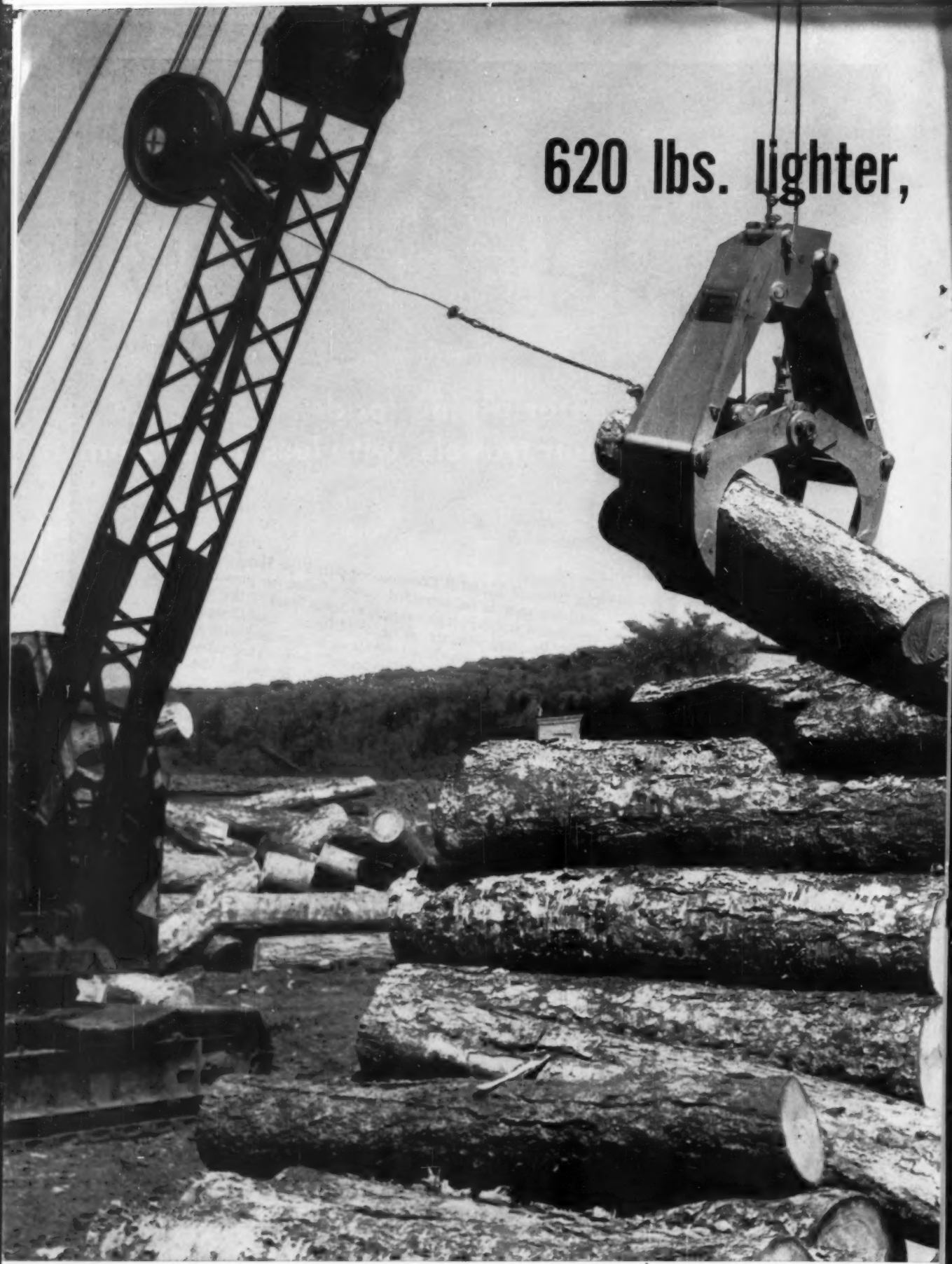
620 lbs. lighter,

more portable, and more durable...

Welded assembly of USS "T-1" Steel cuts grapples weight 47 per cent

It isn't the logs that wear out log grapples like these. But dropping the grapples 10, 25, or 30 feet, twice a minute, hour after hour, day after day, does wear them out. They literally destroy themselves. That's why light weight is important. And toughness. And strength.

Mack Welding Company, Duluth, Minnesota, has cut weight of grapples 620 lbs. and simultaneously *increased* durability, just by switching from mild steel to rugged USS "T-1" Steel. Here is what they say about "T-1":

"We thought we had reached the lowest possible weight when we manufactured a previous model weighing 1300 pounds. But these new grapples made from your "T-1" Steel weigh only 680 pounds—just a little over half as much. That's an important advantage for loggers who have relatively small-capacity truck-mounted cranes. No other rolled steel plate would give us such light weight in grapples capable of handling loads up to 3 tons."

"T-1" WELDS BEAUTIFULLY

"As far as fabrication is concerned, we find that "T-1" Steel welds beautifully and can be flame-cut in exactly the same way as mild steel, without distortion or any other difficulty. We're very pleased with it."

"T-1" Steel is unique. For it gives you a combination of high tensile and yield strength (105,000 psi and 90,000 psi), good high temperature strength, extreme toughness at sub-zero temperatures, good resistance to abrasion, impact, and abuse. You get all of these properties in one steel that is easy to weld.

You can use "T-1" to reduce weight . . . to lengthen service life . . . to reduce costs. Look around you. You'll find a job for it—a job that no other steel can do so well. United States Steel, Room 5143, Pittsburgh 30, Pa.

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USS "T-1" CONSTRUCTIONAL ALLOY STEEL

USS

6-59

UNITED STATES STEEL

Cylindrical Rollers for High Capacity...

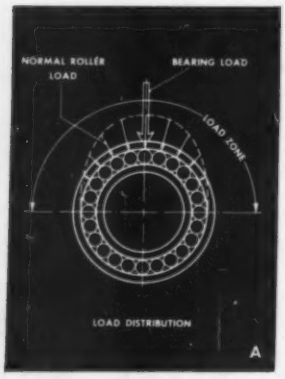
How the rollers distribute the load... effect of local deflection within rollers under load... how roller quality control increases bearing life

The principle of overcoming sliding friction with rollers was known even to the ancient Egyptian pyramid builders, but it is a far cry from their crude logs to precision-ground rollers. Today engineers have a wide choice of bearing designs, and selection is usually gaged by the fundamental yardsticks of accommodation, load-carrying capacity and cost. In many applications, properly designed plain bearings provide operating advantages. Ball bearings are ideal for other applications. But where heavy loads must be sustained in a relatively small bearing annulus, the only practical, commercially-available support is a set of hardened rollers operating in planetary fashion around a hardened inner race and housed in a hardened outer race . . . in other words, a *cylindrical roller bearing.*

Obviously, the design and quality of the *rollers* play a large part in the performance of the bearing. Here, briefly, are some of the vital factors which must be taken into consideration:

1. DISTRIBUTION OF LOAD WITHIN THE BEARING

Every roller in a rotating bearing is subjected to periods of load while in the "load zone," and periods of no load while outside the "load zone." Within this zone, the roller moves from a position of light load to a position on the line of action of the bearing load. Here the normal roller load is a maximum, and the roller in this position is the heaviest-loaded roller in the bearing. Moving beyond this point, the load diminishes to zero at the extremity of the "load zone," as shown in Diagram A at the left.

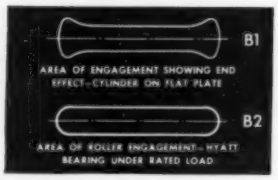


The theoretically perfect "load zone" extends from $-90°$ to $+90°$ measured from the line of action of the bearing load, for a total of 180°. But this is neither practical nor necessarily desirable, since it would require a bearing of zero internal clearance. If a bearing has internal clearance, then it has no "load zone" when under no load; only after load is applied does the heaviest-loaded roller deflect and permit its associates to share the load.

Under normal loadings, the actual "load zone" may range from 90° to 120°, depending on the load and mounted internal clearance. This distributes the load in the bearing so that the load on the heaviest-loaded roller can be approximated by 5/N times the bearing load, where N is the number of rollers.

2. DISTRIBUTION OF LOAD WITHIN ROLLER'S AREA OF CONTACT

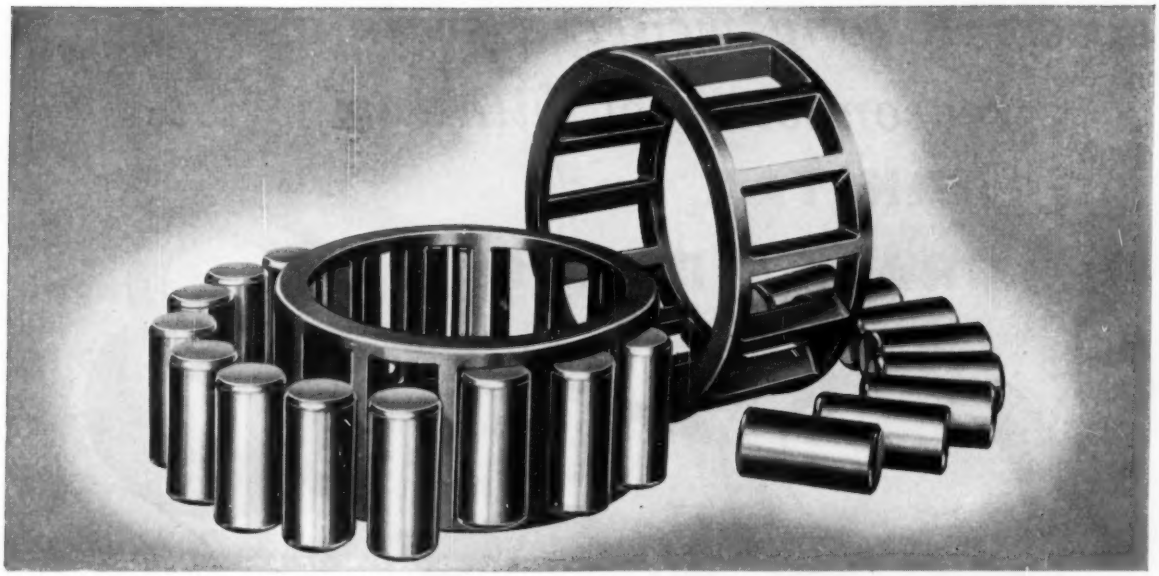
As load is applied to a cylinder between flat plates, the cylinder deflects locally in the region of engagement. The plate also deflects locally, so the original line of engagement under no load is broadened to become a "dog-boned" area (Diagram B1) under load. This broadening of the line of contact is analogous to the spread of the "load zone" from the heaviest-loaded roller to adjoining rollers, as previously described.


B1
AREA OF ENGAGEMENT SHOWING END EFFECT—CYLINDER ON FLAT PLATE
B2
AREA OF ROLLER ENGAGEMENT—HYATT BEARING UNDER RATED LOAD

One other effect is prominent here: deflected cylinders of finite length must gather in metal at their ends in *two planes*, instead of one, as is the case in the center of the roller. *This end-loading effect can seriously reduce the life of a cylindrical roller bearing.* All HYATT Roller Bearings have rollers of either generous corner radii or blended chamfers to reduce end effect. All HYATT Hy-Load Bearings, in addition to generous corner radii on the rollers, have a roller crowning extending a sufficient distance in from the ends to allow the area of contact to "fade out" evenly at the roller ends under normal loads, as illustrated in Diagram B2 above.

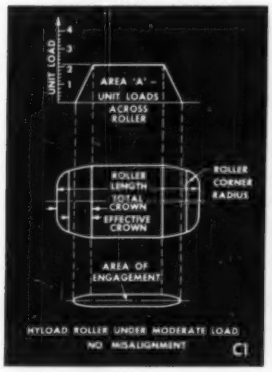
3. DISTRIBUTION OF LOAD ACROSS THE ROLLER

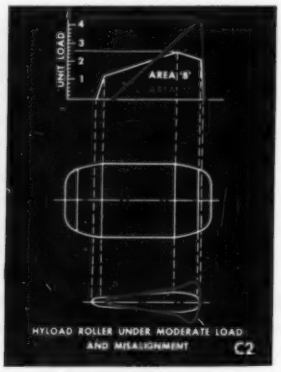
The unit load on any roller is distributed axially in a uniform manner except at the ends where crowning has been provided. Diagram C1 shows how the unit load drops off to zero at the



ends of the area of contact. The summation of unit loads represented by area "A" is the total roller load.

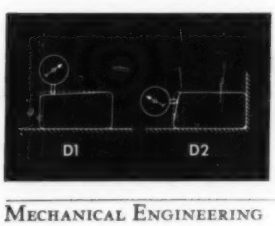
This same load applied under conditions of misalignment must result in an area "B" equal to area "A"; but it is apparent that the maximum unit load is considerably greater under such conditions and that the bearing will have a shorter life than one operating with little or no misalignment. Now observe the high unit load represented by area "C," resulting from the same total load applied to an *uncrowned* roller. This aptly demonstrates the value of crowning under conditions of misalignment. Moreover, the value of proper alignment is equally apparent (Diagram C2).



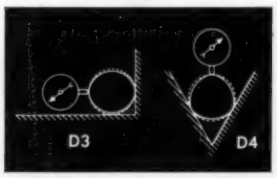


4. EFFECT OF ROLLER QUALITY ON BEARING PERFORMANCE

Quality of manufacture, particularly that of the rollers, has a great deal to do with the performance of a cylindrical roller bearing. For example:



1. A roller with excessive *taper* tends to uneven load distribution and abnormal temperature rise (D1).
2. A roller with excessive *end square* tends to noisy bearing performance (D2).
3. A roller with excessive *two-point out-of-round* tends to poor segregation and poor bearing life (D3).
4. A roller with excessive *three-point out-of-round* tends to noisy bearing operation (D4).
5. A roller with *poor finish* tends to wear on all operating surfaces and noisy operation.



6. A bearing with excessive *roller-to-roller diameter variation* tends to poor bearing life.
7. A bearing with excessive *roller-to-roller length variation* tends to poor thrust capacity and abnormal temperature rise.

All of these factors are scrupulously controlled by the most modern precision equipment to insure maximum performance and life for every HYATT Roller Bearing. HYATT has pioneered many advancements in the control of roller quality and is constantly seeking new ways to carry the complex loads of modern industry even more efficiently.

YOU WILL FIND MORE DETAILS in HYATT General Catalog No. 150, or your nearby HYATT Sales Engineer will gladly help you choose the type of cylindrical roller bearings best suited to your design requirements. Remember, HYATT is America's *first* and *foremost* maker of cylindrical roller bearings. Hyatt Bearings Division of General Motors, Harrison, N. J.

GM GENERAL MOTORS

HYATT
ROLLER BEARINGS

efficient, long-wearing seals produced at reasonable cost with compatible

GRAPHITAR® *and*

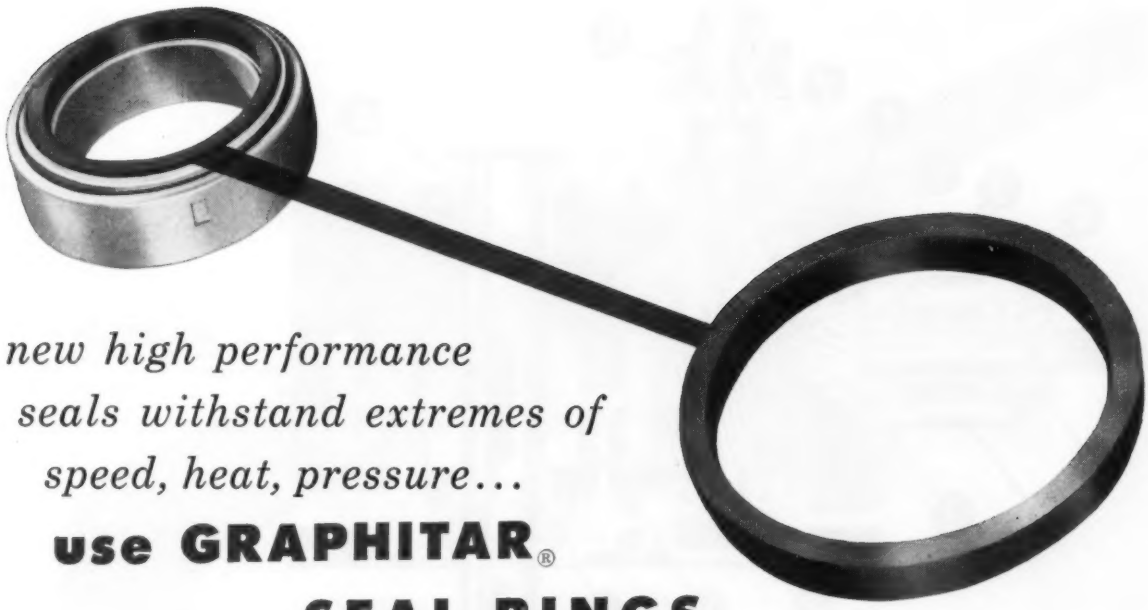
GRAMIX® PARTS

GRAPHITAR is not only a high-quality seal material, but when produced in volume, an economical one as well. In low-pressure applications where mechanical seals have heretofore been too expensive, the Gits Bros. SGU stock shaft seal, using GRAPHITAR wearing and sealing elements, is finding wide use. Cost of the GRAPHITAR seal rings is reasonable enough to make the SGU practical in such high-volume products as washing machines, garbage disposal units, and pumps. Performance is excellent, due to GRAPHITAR'S low friction, high strength, durability, self-lubricating properties and its guaranteed continuing inertness to all known detergents. The long life of the SGU seal is further assured with a GRAMIX Grade 263 nickel-bronze seal-seat. GRAMIX Grade 263 is also corrosion resistant to detergents and the wear and sealing-in characteristics are especially compatible with those of GRAPHITAR. As a result, the Gits SGU shaft seal combines economy with very efficient operation, and is manufactured in standard sizes ¼″ thru 2″ and in shaft increments of ⅛″.

SGU Seal Performance Data:

Speeds.....1750 to 3600 FPM	*Sealed Liquids* Soaps, Greases, Animal Fats, Strong Detergents
Temperatures Continuous.....250°F. Intermittent.....275°F.	*Lubrication* Soaps, Greases, Animal Fats, Strong Detergents and water splash lubrication
Pressures Normal.....10 to 15 psi Maximum.....35 to 40 psi	

THE UNITED STATES



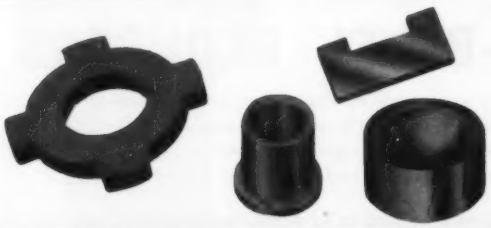
new high performance seals withstand extremes of speed, heat, pressure...

use GRAPHITAR® SEAL RINGS

The Gits Bros. style HH stock shaft seal has been designed for use in aircraft accessories and in other equipment where maximum performance is demanded. This seal meets minimal space requirements, and, due to its GRAPHITAR seal ring, can perform under extremes of temperature, pressure, and seal face surface speed. GRAPHITAR, being an inert carbon-graphite material, is relatively unaffected by such extreme operating conditions, and is likewise unaffected by most chemicals or acids . . . even very corrosive ones. GRAPHITAR possesses excellent sealing qualities, a low coefficient of friction, a long wear life, and is in addition self-lubricating. These properties assure the HH seal of efficient operation with a minimum of maintenance . . . very important in such end uses as jet aircraft, reciprocating accessory units, and hydraulic pumps. Gits Bros. manufacture these seals in *standard sizes* ¼″ thru 4″ and in shaft increments of ⅛″.

HH SEAL Performance Data:

Speeds.....20,000 feet per min.	*Sealed Liquids* Aircraft fuels and oils
Temperatures.....400°F. maximum	*Lubrication* Mists, vapors, full fluid
Pressures.....1000 psi maximum	



VERSATILE GRAPHITAR seals, bearing, vanes, piston liners, and many other parts show improved characteristics. GRAPHITAR parts are made from carbongraphite powders compacted in dies under great pressure and furnaced at temperatures near 4500°F. They can be relatively complicated in shape, and are ground to tolerances as close as .0005″. GRAPHITAR is lightweight, strong, and durable, chemically inert, and virtually unaffected by extremes of speed, pressure, or temperature. It can be operated dry, or where water, steam or another fluid are the only lubricants. Write today for our illustrated 64-page GRAPHITAR catalog.

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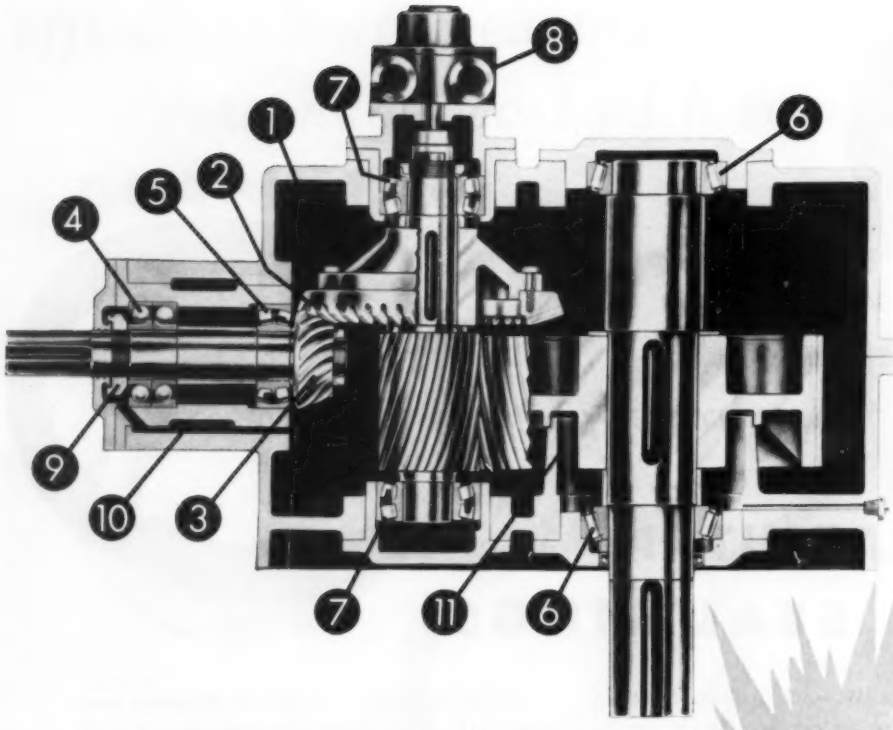


Sectional view of a Double Vertical Type Philadelphia Spiral-Bevel Speed Reduction Unit.

PUT US "ON THE SPOT"

Send For This "Text Book"

. . . make us tell you the "11 points" of superiority of PHILADELPHIA SPIRAL-BEVEL REDUCERS

These units offer a compact, dependable and highly efficient means of transmitting power at right angles. They are available for Vertical (shaft-up, or shaft-down) or Horizontal Mounting; in single, double or triple reductions . . . Reduction Ratios range from 1.5 to 1 up to 238 to 1.

Due to their unique design and construction, they require no separate cooling system, and as can readily be seen, they are very accurately and ruggedly built . . . Thousands are in use throughout industry, driving vital equipment day and night, year-in and year-out.

Yes, we'll be glad to have you "put us on the spot" by asking a Philadelphia Sales Engineer to call, or by asking for our complete 88 page catalog SB-50.

PHILADELPHIA GEAR WORKS, INC.

ERIE AVE. & G ST., PHILADELPHIA 34, PA.
NEW YORK • PITTSBURGH • CHICAGO • HOUSTON • LYNCHBURG, VA
BALTIMORE • CLEVELAND
Virginia Gear & Machine Corp. • Lynchburg, Va.

Industrial Gears & Speed Reducers

LimiTorque Valve Controls

Established 1892

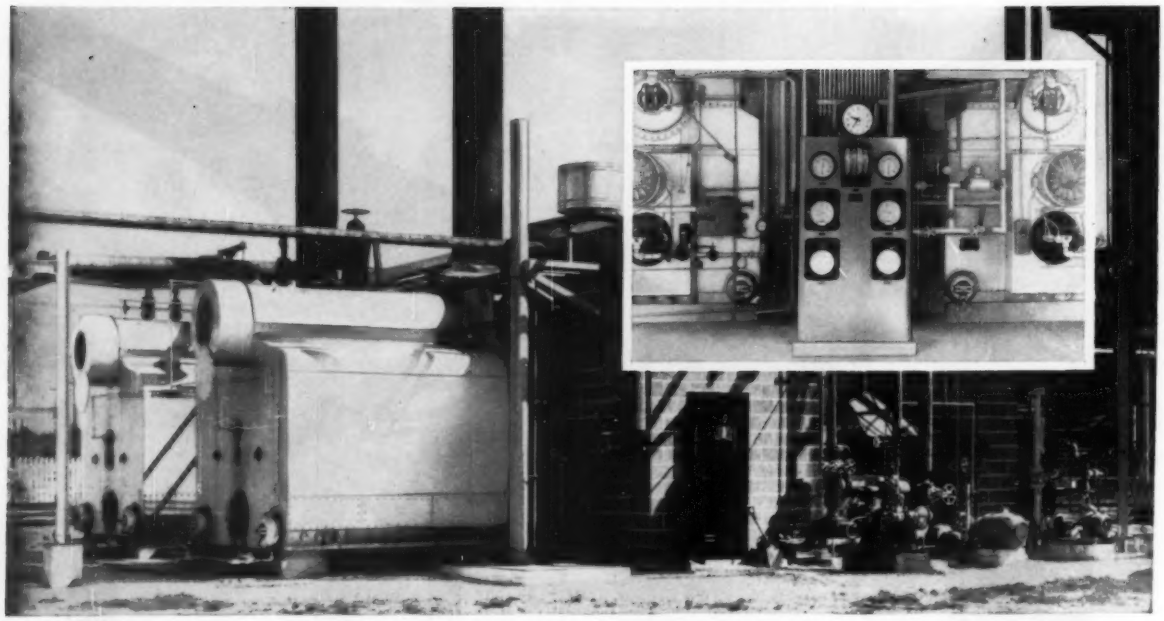
Zallea-designed Expansion Joints assure positive protection from damage caused by pipe movement. The units shown here—gimbal, hinged, and universal types—absorb pipe movements in any direction, imposing minimum forces on adjacent piping, equipment and anchors. An original Zallea development, gimbal expansion joints permit angular movement in any plane, with gimbal ring and hinges built to withstand pressure thrust and to support piping.

Zallea already has, or will design, expansion joints for every service—and to suit any piping layout. Test records show that Zallea Expansion Joints outlast all other packless joints by as much as 1800%. For information on standard types, or consultation on special expansion or piping problems, ask to have a Zallea representative call.

Zallea *expansion joints*

ZALLEA BROTHERS, 820 LOCUST STREET, WILMINGTON 99, DELAWARE

World's Largest Manufacturers of Expansion Joints



Two Union packaged boilers play important role in Davison cracking catalyst plant

Job Report (UIW) — Proving that they can do their job outdoors as efficiently as indoors, two Union Type MH Steam Generators handle a key assignment for Davison Chemical Company, Division of W. R. Grace & Co. They deliver process steam in Davison's large Lake Charles, La. plant which is equipped to produce approximately 45,000,000 lbs. of petroleum cracking catalysts annually.

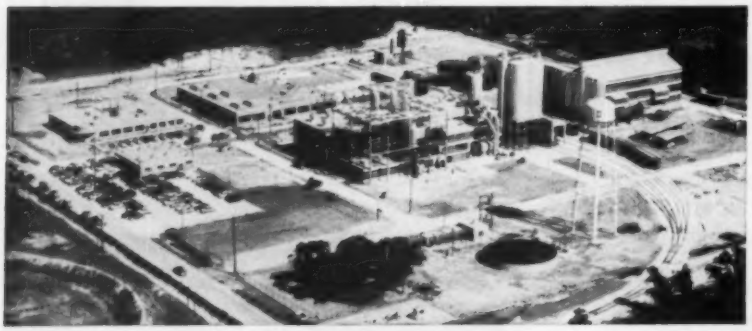
Selected for this important role because of "reputation . . . and delivery," these Union Packaged Steam Generators are reported by Davison to be operating at high efficiency.

Each of the pair has a steam capacity of 18,000 lbs/hr. at 250 psi and is gas fired. Both were completely assembled in Erie, Pa. by Union Iron Works before delivery to their Louisiana job site.

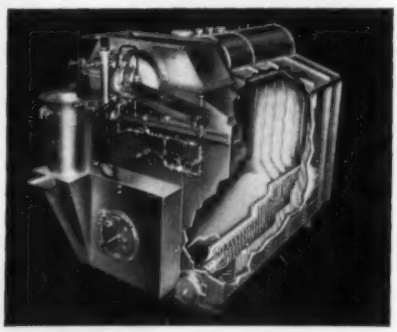
Patterned after larger but similar field erected Type H Boilers, originated by Union over 16 years ago, numerous MH Packaged Units are being installed in chemical processing plants, pulp and paper mills, breweries, refineries, institutions, schools and hospitals.

With standard units designed in 13 sizes from 10,000 to 40,000 lbs/hr. at 250 psi, Union Packaged Steam Generators can be equipped to handle multitudes of needs formerly requiring costly field erection. For example: Superheaters can be installed to meet total temperature requirements, while air heaters and economizers are readily supplied when needed. High pressure units are also available for special applications.

The complete story of Union Type MH Steam Generators, including cut-away illustrations, tube layouts and dimension tables, can be obtained promptly by requesting Bulletin MH-353 from Union Iron Works, Erie, Pa.



Aerial view of Davison Chemical Company's large Lake Charles, La. plant for manufacture of petroleum cracking catalysts.



Cutaway of compact Union Type MH Steam Generator. Tubes arranged for straight-through gas flow with low draft loss.

now you see it
Hold a sheet of Formica XXXP-36 to the light. You can positively identify it by the faint, unmistakable watermark.

now you don't
Remove the light and the watermark disappears. Unobtrusive, positive, permanent. Substitution is impossible.

new **Formica** watermark guarantees highest copper clad quality

The watermark now appearing in every sheet of the new Formica XXXP-36 laminated plastic positively and permanently identifies it as the high IR, cold punching sheet you purchased.

No other laminate carries such a seal of guarantee. Only FORMICA XXXP-36 gives you such a convenient visual check on quality control throughout your entire circuit fabricating process.

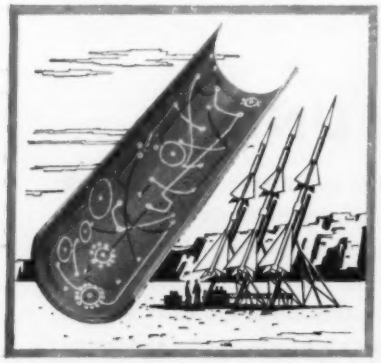
Here's why the new watermark is so important to you: design engineers specify Formica XXXP-36 because it alone offers the double value of (1) cold punching up to an including 1/16" thickness, and (2) one million megohms insulation resistance after 96 hours at 95° F at 90% relative humidity. Obviously production must be able to separate the cold punching XXXP-36 from the ordinary hot punching grades, and this is done simply by visual on-the-spot inspection.

The watermark is useful to electronics manufacturers in many other ways, too. It identifies XXXP-36 as the sheet with the accuracy so indispensable to automatic printed circuit assembly.

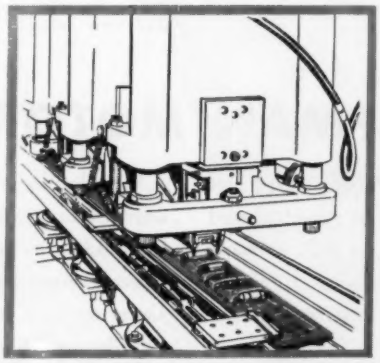
Identification with the Formica watermark is so quick, easy and positive, it will save you real money by eliminating undependable systems of stickers, labels and front office records.

The XXXP-36 watermark is another Formica quality service that delivers *quality you can see*, for better printed circuitry. For complete information on XXXP-36 and Formica's 12 other outstanding copper clad laminates, send today for free bulletins 599 and 457 and Data Sheets.

The Formica Company
4611 Spring Grove Ave., Cincinnati 32, O.



Super heat resistance
—necessary for guided missiles—now available in Formica's new FF-91 epoxy type copper clad which also offers super IR, better bond strength and better all around circuit performance. (The 180° arc shown is molded.)

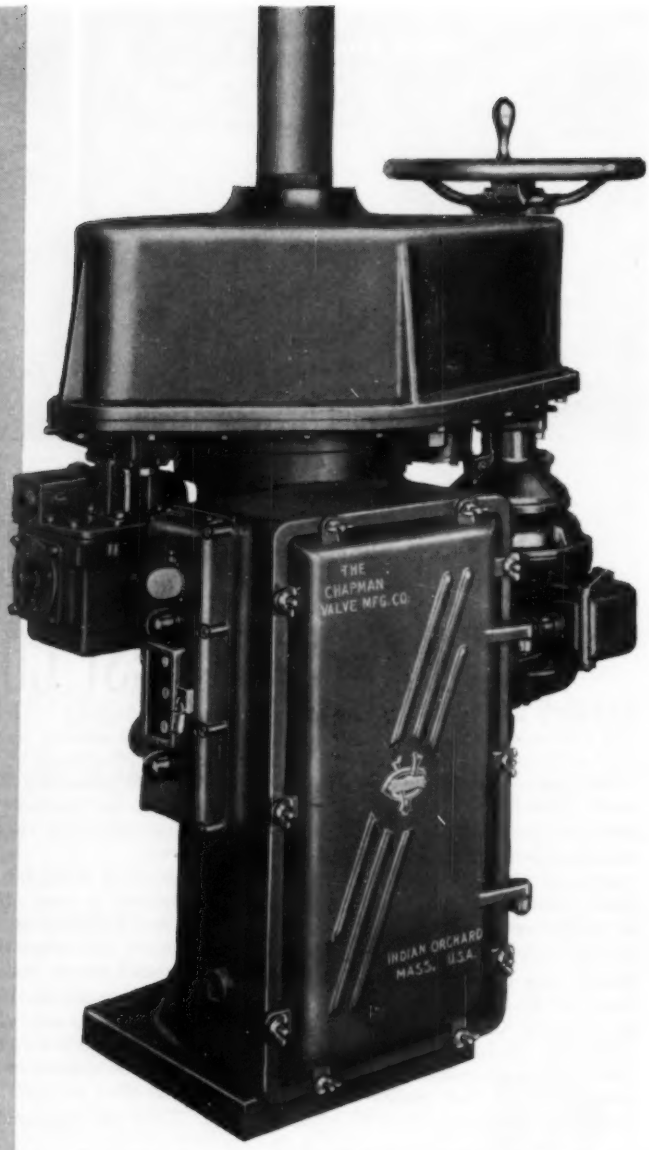


Automation accuracy
The uniformity required for automatic circuit assembly is provided by XXXP-36 and Formica's other cold punching copper clad laminates. Cold punching eliminates dimensional change resulting from heating.

Circuits by the yard
Formica copper clad laminates are available in more and larger sheet sizes. This greater selection eliminates unnecessary cutting, reduces waste, assures economy in fabrication no matter how large the circuit.

Fewer Parts Mean Greater Dependability

Floorstand Motor Unit . . . control panel, motor, limit switch and push button station.



Simple, durable mechanism of Chapman's Motor Unit. Handwheel remains stationary during motor operation.

IN CHAPMAN MOTOR UNITS

Chapman's simple and rugged Motor Unit gives accurate, trouble-free control of large valves and sluice gates. It has approximately *half as many parts* as any other unit. Its simplified design, low speed motors and low-ratio, stubtooth gears combine to give positive operation without drift, in *any* position and under all conditions.

Installation is fast and simple. The floorstand unit comes completely wired, ready to connect to leads. Limit switch has micrometer adjustment for exact pre-setting for seating tightness. Motor Units operate smoothly under the most adverse conditions. All units are weather-proof and steam-tight. Write today for *new* Catalog 51.

The Chapman Valve Manufacturing Co.

INDIAN ORCHARD, MASSACHUSETTS

Idea Sparkers

for your next

BEARING PROBLEM

Have you ever compromised design because you had to sacrifice bearing capacity? Perhaps it was due to high operating temperatures, housing materials, or need for seals operating under extremes of dirt or water. Then you will be interested in these "idea sparkers" from designers who used Shafer Self-Aligning Roller Bearings on applications where . . .

. . . operating speeds average 3800 r.p.m. and go as high as 5000 r.p.m. 30% of the time. High temperatures? Sure! Internal bearing temperatures run up to 240°, but these Shafer Cartridge Units have proved that they can deliver the performance and are replacing all units formerly specified in the design.

. . . Micro Lock adjustment, compensating for high wear rates on one application, has added 30% to bearing life formerly experienced. This feature alone has resulted in an annual saving of many thousands of dollars in bearing replacement costs.

. . . moderate overhung load on 5" shaft caused a shaft deflection at load of .0325", resulting in severe overload at bearing. Inherent self-alignment of the Shafer unit now specified, instantly compensates for this deflection, providing the required service life and performance.

. . . size of pillow block housing on unit was working a difficult mounting restriction on the design. Better distribution of metal in the Shafer housing provides the most efficient use of metal . . . eliminates the excess bulk and unnecessary weight, solving the problem of mounting.

TURN THIS PAGE FOR MORE INFORMATION

CHAIN BELT COMPANY

LEADERSHIP . . . through creative engineering

IDEA SPARKERS (CONTINUED)

... an advantage was found by another manufacturer for itself as well as its customers. Because of the interchangeability of Shafer components, parts stocking became an easier, less expensive job. Shafer Bearing Division is the only bearing manufacturer that offers this feature.

SHAFER Self-Aligning Roller Bearings

Offer More Capacity — Positive Sealing — Self-Alignment — Housing Strength for All Applications

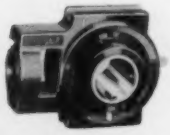
Pillow Blocks: Normal and Heavy Duty from ¾" to 7" shaft sizes, 2 and 4 bolt base types. Also, expansion type and adapter mounting units.

Flange Cartridge Units: Normal and Heavy Duty from ¾" to 5" shafts. Bore tolerance of mountings — plus .002", minus .000".

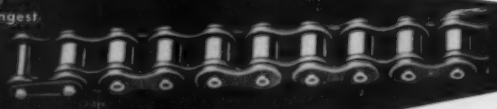
Flange Units: Normal and Heavy Duty from ¾" to 5" shaft sizes. Also available with a flange pilot.

Take-Up and Frame Units: Normal, Heavy and Extra Heavy Duty from 1-15/16" to 4-7/16". Special reinforcements for greater capacity.

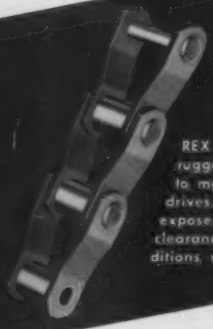
Cartridge Units: Normal and Heavy Duty from ¾" to 7" shafts. Cartridge housing drilled and tapped for lubricating fitting.



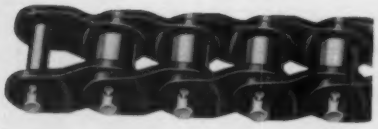
Take-Up Units: Normal and Heavy Duty from ¾" to 4" shafts. Guide slots milled for sufficient clearance to operate on hot-rolled guide bars.



REX ASA ROLLER CHAINS ... precision-built chains for moderate to high-speed drives. Exclusive pitch control system assures longest possible service life.



REX CHABELCO STEEL CHAINS ... rugged, heavy-duty chains for slow- to moderate-speed, heavy-load drives. Ideal for operation in exposed conditions ... built-in clearances permit operation in conditions of dust and dirt.



REX OFFSET SIDE BAR ROLLER CHAINS combine the high-speed service features of ASA roller chain with the strength and flexibility of Chabelco Chains.

CHAIN Belt Company
Dept. DP-1
Milwaukee 1, Wis.

- ☐ Send me informative literature on Shafer Bearings.
- ☐ Send me informative literature on Rex Drive Chains.
- ☐ I would like to have a CHAIN Belt District Sales Engineer call.

NAME .....

COMPANY .....

ADDRESS .....

CITY..... ZONE..... STATE.....

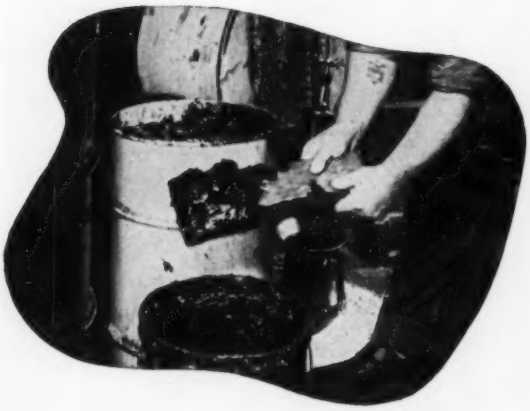
CHAIN BELT COMPANY

MILWAUKEE 1, WISCONSIN

EASY WAY TO PUT OUTPUT ON THE UPSWING!

shift lubrication methods from

Backward to Forward!



ALEMITE AIR-OPERATED TRANSFER PUMP

gives 63% faster lubricant transfer

...saves right down the line!

The *real cost* of plant lubrication is not just the *lubricant* alone! Actually, it's the time and labor needed to get the lubricant *out* of the original drum—*into* a bucket pump or powergun—and then *applying* it to machine bearings. That's where the real costs add up!

And that's why an Alemite Air-Operated Transfer Pump can cut costs in your plant—especially if you are using old-fashioned hand methods of lubrication. It transfers 37 pounds of pressure gun grease *per minute*—direct from the original drum—completely sealing the lubricant at all times—protecting against mess, waste and contamination.

It's fast—and versatile! It can even handle alcohol, cutting oils, kerosene—almost any non-corrosive non-abrasive fluid you use by the drum. Delivers light fluids at a rate of up to 15 gallons per minute!

There's no better way to speed up your handling of lubricants—because an Alemite Transfer Pump pays for itself by saving man-hours and machine-hours as well!

• A 400-pound barrel of lubricant arrives at the plant—sealed, fresh, "refinery clean."

• An Alemite Transfer Pump is inserted in the bung-hole. It is threaded to fit—completely reseals the barrel.

• In less than a minute a 25-pound bucket pump is filled! No contamination, no air pockets, no mess or waste!

• Now the bucket pump is ready to service hundreds of hungry bearings with lubricant that is protected all the way from barrel to bearing!

***FREE!* New Booklet:**
"5 Plans for Better Lubrication"
Alemite, Dept. LL-36, 1850 Diversey Pkwy.
Chicago 14, Illinois
Please send me my FREE copy of "5 Plans for Better Lubrication."

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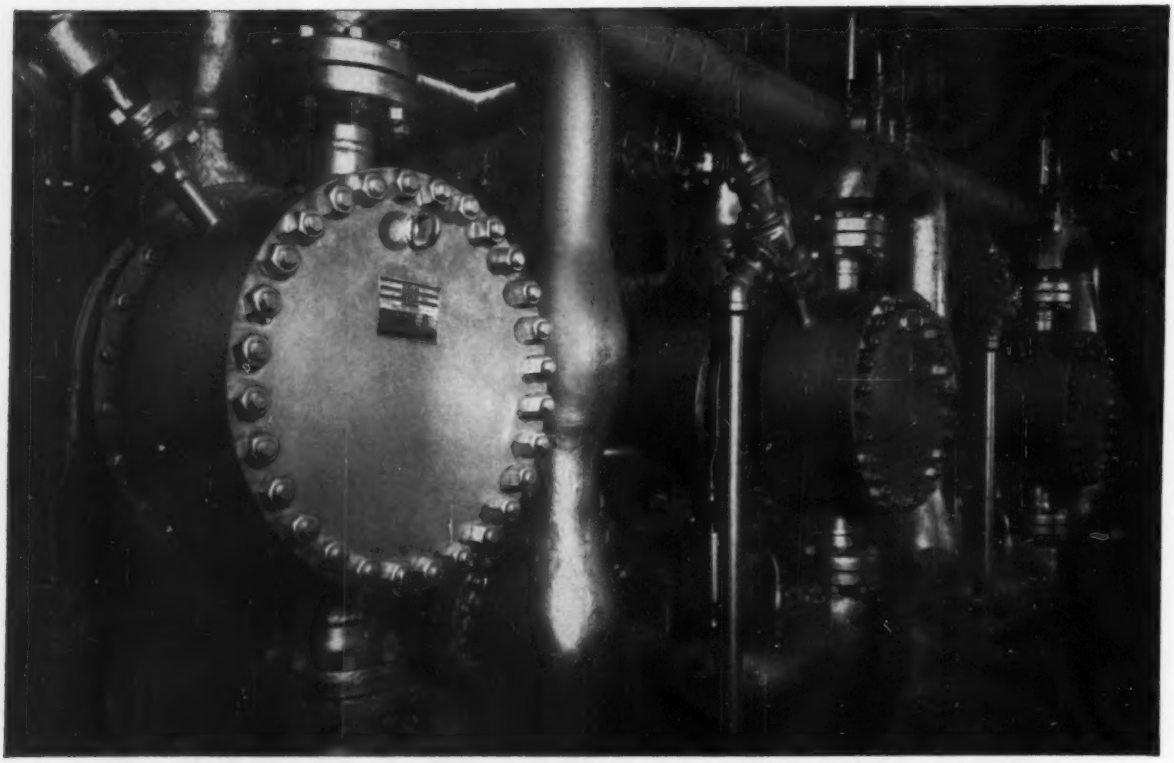
City..... **Zone**..... **State**.....

ALEMITE

Ask anyone in industry

A PRODUCT OF SW STEWART WARNER



THE ROSS STORY

Special Heat Exchange Equipment for Power Plants

Simply stated, Ross designs and manufactures heat exchangers for virtually all conditions and applications, particularly units of a highly specialized nature, such as high pressure power plant equipment...bleeder heaters and fuel oil heaters, for example.

The installation of 6 Ross High Pressure Fuel Oil Heaters (illustrated) at the Pacific Gas and Electric Co.'s Station P Steam Plant in San Francisco is typical. Featuring forged oil channels with integral tube sheets and a double tube sheet arrangement to insure against any possibility of fuel oil contaminating the steam system, these rugged units demonstrate Ross' resourcefulness and experience in dealing with both the average and the specialized power engineering problem.

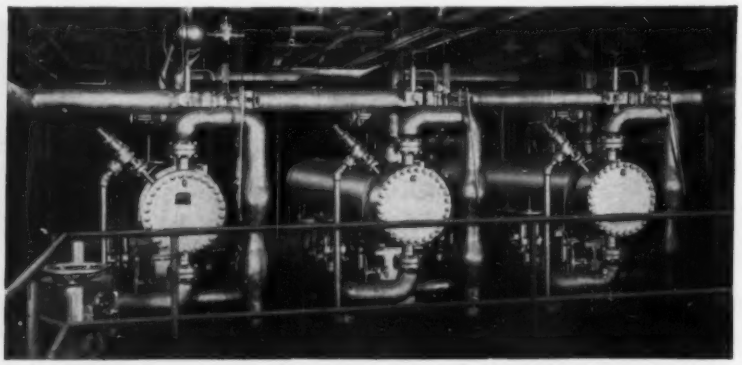
Your requirements, too, can be met with the same, exacting Ross attention to details. Inquire now. Ross offices are in all principal cities.

For recommendations on specialized heat exchangers, as well as on surface condensers, turbine oil coolers, engine oil and water coolers, compressor inter and after coolers and related power plant equipment, you'll profit by consulting a Ross engineer.

ROSS

ROSS HEAT EXCHANGER DIVISION
of
AMERICAN - Standard

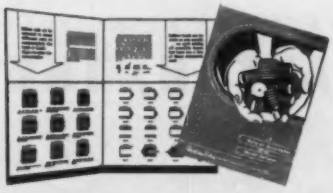
1448 WEST AVENUE • BUFFALO 13, N. Y.
In Canada: Kawanee-Ross of Canada Limited, Toronto 5, Ont.



YOUR No. 1 SOURCE FOR COMPLETE BELLOWS ASSEMBLIES AND DEVICES

FULTON SYLPHON
BELLOWS HEADQUARTERS, U.S.A.

You gain three important advantages when you consult Fulton Sylphon, originators of the metal bellows—*1.* Over 50 years experience in bellows engineering is focused on your problem; *2.* Modern production facilities geared to good service; *3.* Cost saving opportunities through the design and production of complete bellows assemblies.



HERE'S HELPFUL INFORMATION
This 32 page catalog covers basic bellows engineering, conversion tables, metals available and other bellows data. Use the handy coupon for your free copy.

Mr. Controls®

Robertshaw-Fulton
CONTROLS COMPANY

FULTON SYLPHON DIVISION
Knoxville 1, Tennessee

( ) Please have a Bellows Engineer call me for an appointment.
( ) Send me Bellows Catalog #EK1400.

Name_____ Title_____

Company_____

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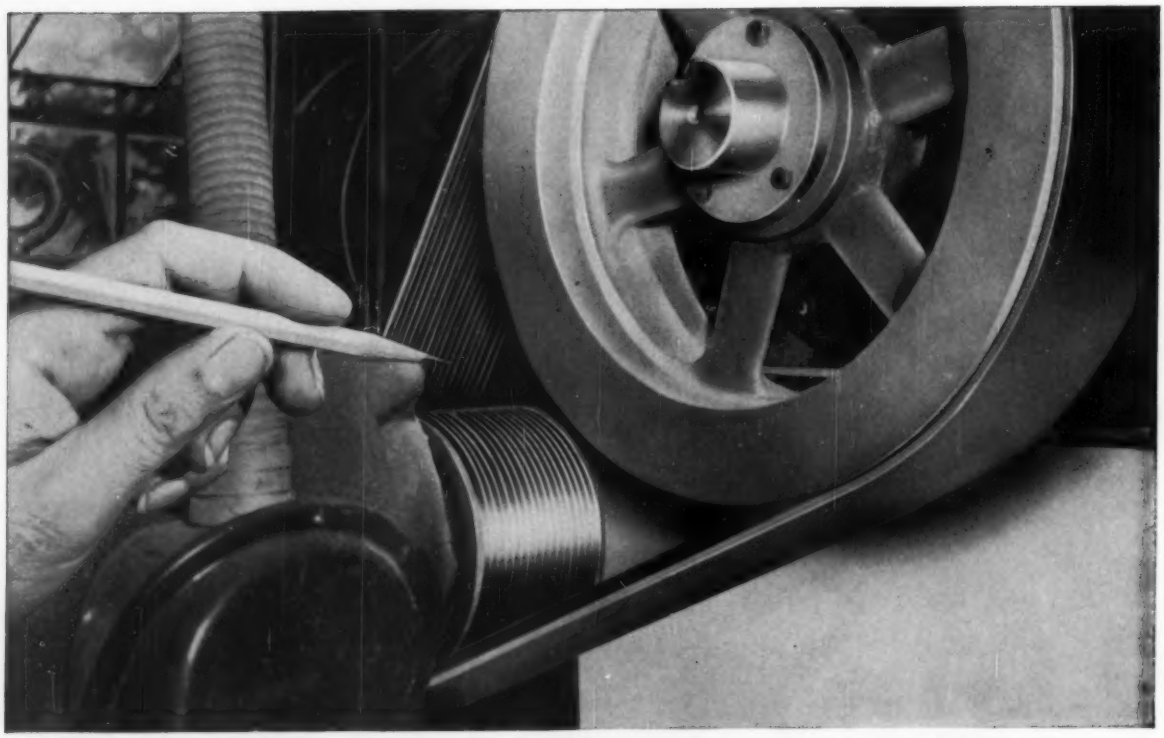
City_____ State_____



This Space Saving Drive Solves Difficult Design Problems . . New R/M *Poly-V® Drive*

Could greater power capacity in less drive space mean an improvement in your equipment drive design? It can be done with R/M Patented Poly-V* Drive . . . R/M's totally new concept in heavy-duty power transmission! Actual installations have proved that this belt drive can deliver up to 50% *more* power in the same space as ordinary multiple-belt drives . . . or *equal* power in as little as 2/3 the space!

The unusual space-saving advantages of R/M Poly-V Drive are the result of over 5 years development by R/M engineers. Employing a single, endless parallel V-ribbed belt running on sheaves designed to mate precisely with the belt ribs, gives Poly-V Drive the strength and simplicity of flat belts *plus* the high V-groove grip of V-belts. It means you get twice the tractive surface of multiple V-belts in the same drive width . . . twice the power capacity . . . "More Use per Dollar".

OTHER IMPORTANT ADVANTAGES INCLUDE:

- Single Unit Design — Eliminates Belt Matching Problems
- More Uniform Tension — Prolongs Belt and Sheave Life
- Two Belt Cross Sections — Meet Every Heavy Duty Power Transmission Requirement
- Oil Proof, Non Spark, Heat Resistant

Investigate R/M Poly-V Drive for the improved design of both new and existing equipment. R/M engineers will gladly work with you on power transmission drive problems. Contact an R/M representative.

CONDOR V-BELTS • R/M SUPER-POWER V-BELTS

Write for Bulletin #6868 on the complete line of Condor V-Belts for regular service on conventional V-belt drives. Also write for Bulletin #6628 on R/M Super-Power V-Belts with 40% more Horsepower capacity where needed.

*Poly-V is a registered Raybestos-Manhattan Trademark

RM 627

R/M

MANHATTAN RUBBER DIVISION — PASSAIC, NEW JERSEY

RAYBESTOS-MANHATTAN, INC.

Other R/M products include: Industrial Rubber • Fan Belts • Radiator Hose • Brake Linings • Brake Blocks • Clutch Facings Asbestos Textiles • Packings • Engineered Plastic, and Sintered Metal Products • Laundry Pads and Covers • Bowling Balls

Introducing . . .

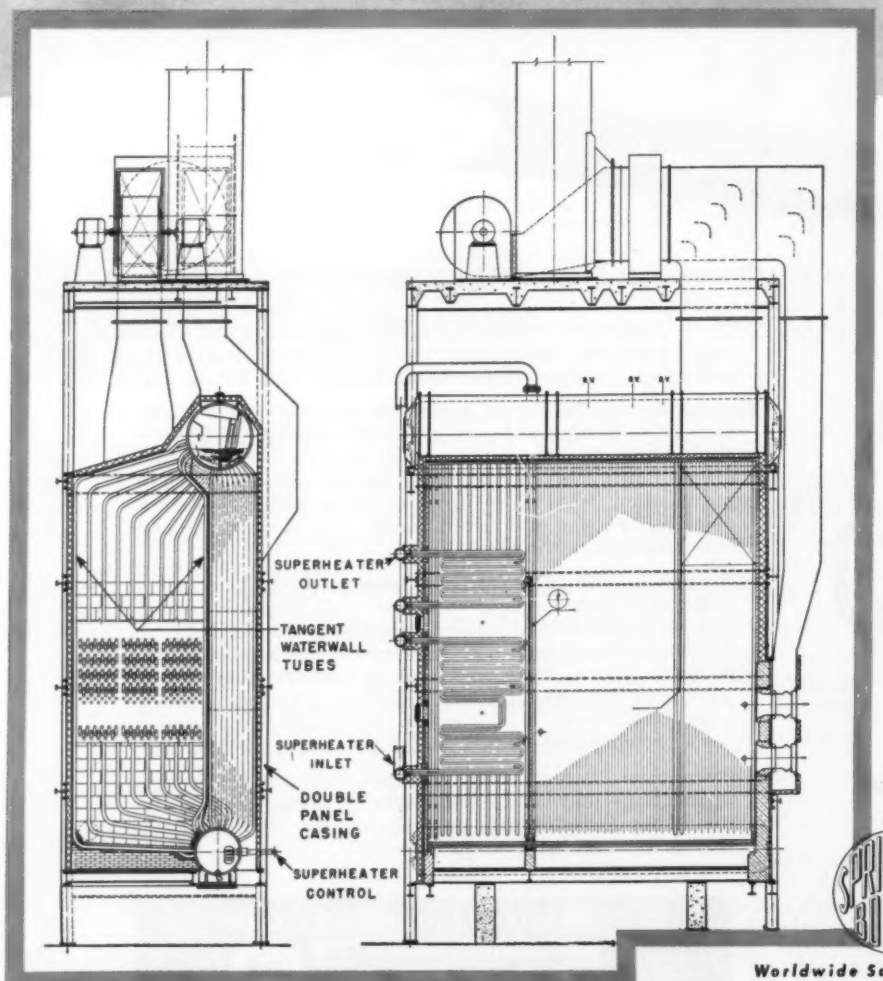
Springfield's New Headerless Steam Generators

SPRINGFIELD BOILER CO., America's first builder of waterwalls for boiler furnaces . . . pioneer builder of divided furnaces . . . and originator of many special features in package boilers, now offers a distinctively new line of specially designed, field erected steam generators that are:

1. Remarkably lower in initial cost.
2. Quicker and simpler to erect.
3. Suitable for indoor or outdoor installation. Completely steel enclosed.
4. Capable of quick starting and quick steaming. Fast circulating.
5. Highly efficient and suited to either pressurized or balanced draft firing. Guaranteed performance.
6. Compact in dimensions and adaptable to user's space requirements.
7. Easier, simpler, and less expensive to operate and maintain.

All waterwall and boiler tubes connect directly to the drums. Tangent tubes are used in the sides, roof, and bottom waterwalls. Water-steam circulation friction is reduced to less than one-quarter of that of conventional designs. The rapid circulation obtained contributes to clean operation, quick steaming, and long tube life.

Units of this type are particularly suitable for installations in the range from 50,000 to 150,000 lbs. per hour. Heat recovery and superheat equipment can be provided as desired. Control and operation can be made virtually automatic. *For detailed information, write or call Springfield today.*



New Unit:

The design shown at the left in front and side elevations is one of Springfield's new headerless generators being built for the City of Chanute, Kansas.

DATA

Des. Pres.	475 psig
Opr. Pres.	425 psig
FST (con.)	750° F.

Continuous Capacity 125,000 lb./hr.

Fuel: Nat. Gas or Oil

Heat Recovery: Air Heater

Consultants
Universal Engineering Company, McPherson, Kansas

Check with Your Consulting Engineer on Modernization and New Plant Projects

Designers and Builders of
BENT TUBE BOILERS • STRAIGHT TUBE BOILERS
SUPERHEATERS • DESUPERHEATERS • AIR HEATERS
ECONOMIZERS • PACKAGE BOILERS

Worldwide Sales and Service
SPRINGFIELD BOILER CO.
FOUNDED IN 1890
1961 E. Capitol • Springfield, Illinois
See our catalog in SWEET'S

Elevated Temperatures

Destructive Fluids

Costly Leaks

New LINEAR Compounds Answer Difficult Sealing Questions

Through pioneer research in the utilization of new polymers and elastomers, LINEAR provides new answers to problem sealing applications in hydraulic systems.

Smashes through the thermal barrier! At elevated temperatures, conventional ring packing compounds cannot withstand *Aromatic Fuels, Aroclor, Dow-Therm-A, MIL-L-7808* and other diester fluids. LINEAR "O" Rings molded with WJ-70 compound, were tested up to 78,000 cycles at 500°F. They show absolutely no sign of deterioration . . . no change in the precise dimension of the rings!

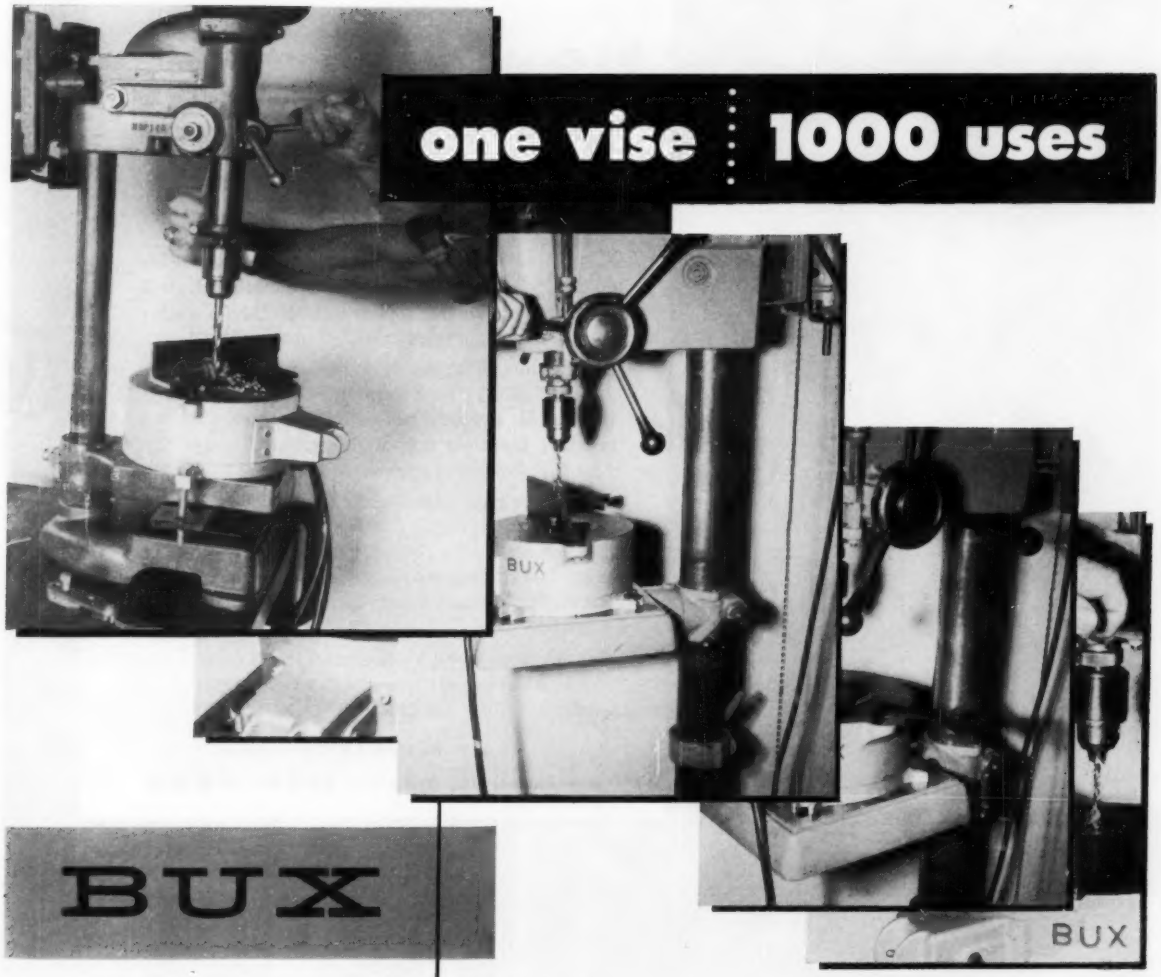
Withstands both flammable and non-flammable fluids! LINEAR homogeneous molded parts including "O" Rings, V Rings, Cups or Fabric Reinforced Vee-Dam Rings compounded from YJ-70 provide perfect sealing in hydraulic systems using such fluids as *Skydrol, Pydraul, Lindol,* or mediums that contain *Tri-Cresyl-Phosphate.* In these, as well as in flammable petroleum base fluids, YJ-70 resists deterioration . . . makes packing changeovers unnecessary, regardless of the fluid used.

These new LINEAR compounds have widespread industrial application—may help solve a difficult sealing problem for you. They are additional examples of why it pays you to rely on LINEAR'S experience.

"PERFECTLY ENGINEERED PACKINGS"

LINEAR

LINEAR, Inc., STATE ROAD & LEVICK ST., PHILA. 35, PA.



BUX magnetic vise

BUX magnetic vise $235 list.*

A flip of a switch can now make a drill meet almost any drilling need. The flip of a switch on the revolutionary BUX **magnetic** vise. BUX holds your job in the unwavering jaws of a tremendously powerful magnetic field.

For production drilling, the two locating arms adjust just once, and are then held in perfect position for the duration of the run. How easily this is done, how easily and how certainly BUX can cut hours upon hours from your production time is a story too valuable to miss. Get it from your BUX dealer. Today is none too soon. Call him now, or send the coupon for fully descriptive information. BUX magnetic products also include portable magnetic drill presses adaptable to ANY standard portable drill, and portable magnetic plate clamps for use in welding heavy steel plates.

*Prices subject to change without notice.

Get full details TODAY

Mail this coupon →

BUX magnetic products—made by Buck Mfg. Co., 108 Roberts Road, Los Gatos 6, California.

Please send us complete literature about the new BUX magnetic drill vise along with the name of our BUX dealer.

NAME_____

ADDRESS_____

CITY_____

How we S-T-R-E-T-C-H valve life

Every Powell Valve comes with a long, dependable life built-in. We make certain that every Powell Valve will give long, trouble-free service through careful quality control of every step of manufacture.

Quality control begins with the very materials and metals of which Powell Valves are made. For instance, the tensile strength test—stretching metal to the breaking point—is one of the numerous ways that *Powell Valves have Performance Verified.*

As a final step in manufacture, every Powell Valve is subjected to *an actual line test.* Because of Powell's painstaking quality control, plant shutdown through valve failure is greatly reduced. Records from refineries, power and industrial plants the world over prove it.

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Cincinnati 22, Ohio . . . 110th YEAR

PERFORMANCE
PV
VERIFIED

FIG. 11303 WE—1500-Pound Pressure Seal Steel Gate Valve.

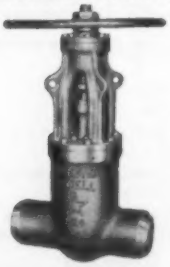


FIG. 3059G—300-Pound Steel Lubricated Plug Valve. Gear Operated. Sizes 6″ to 12″.

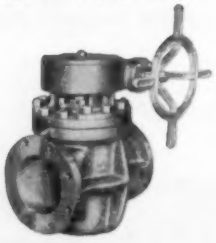
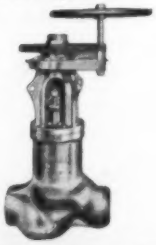


FIG. 19084 WE—900-Pound Pressure Seal Non-Return Globe Valve. Gear Operated.



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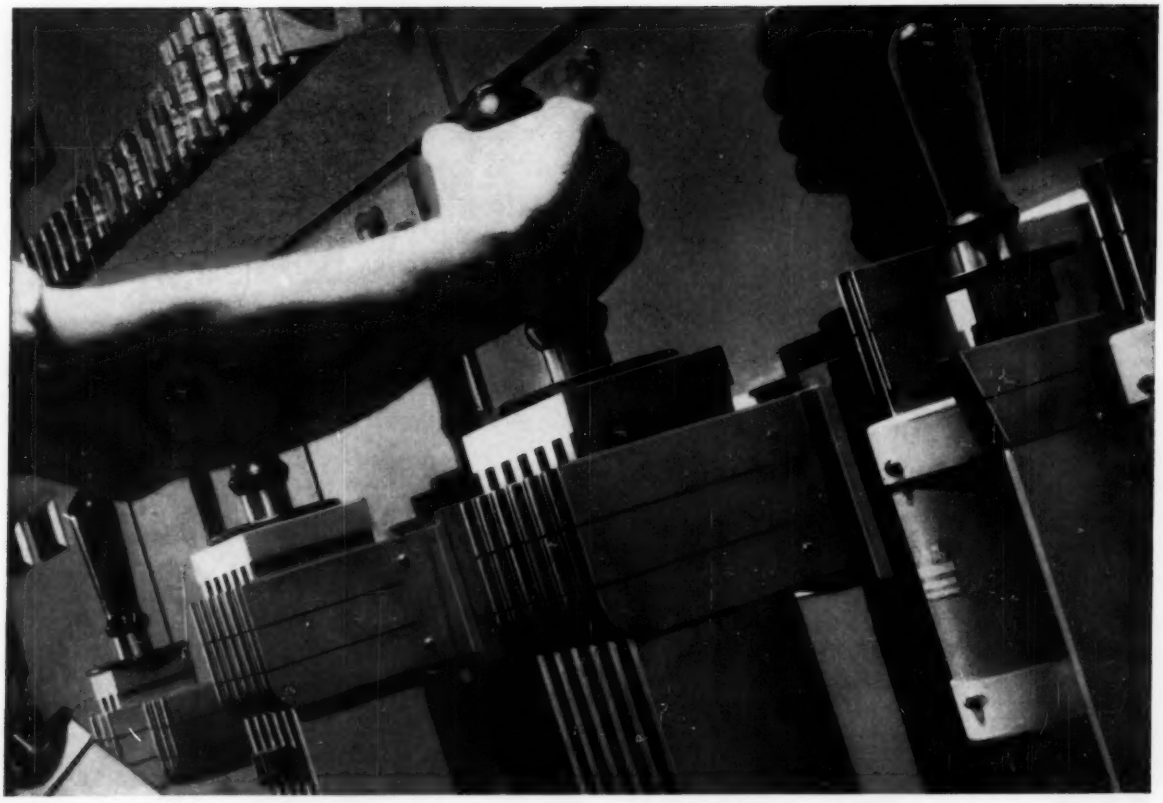

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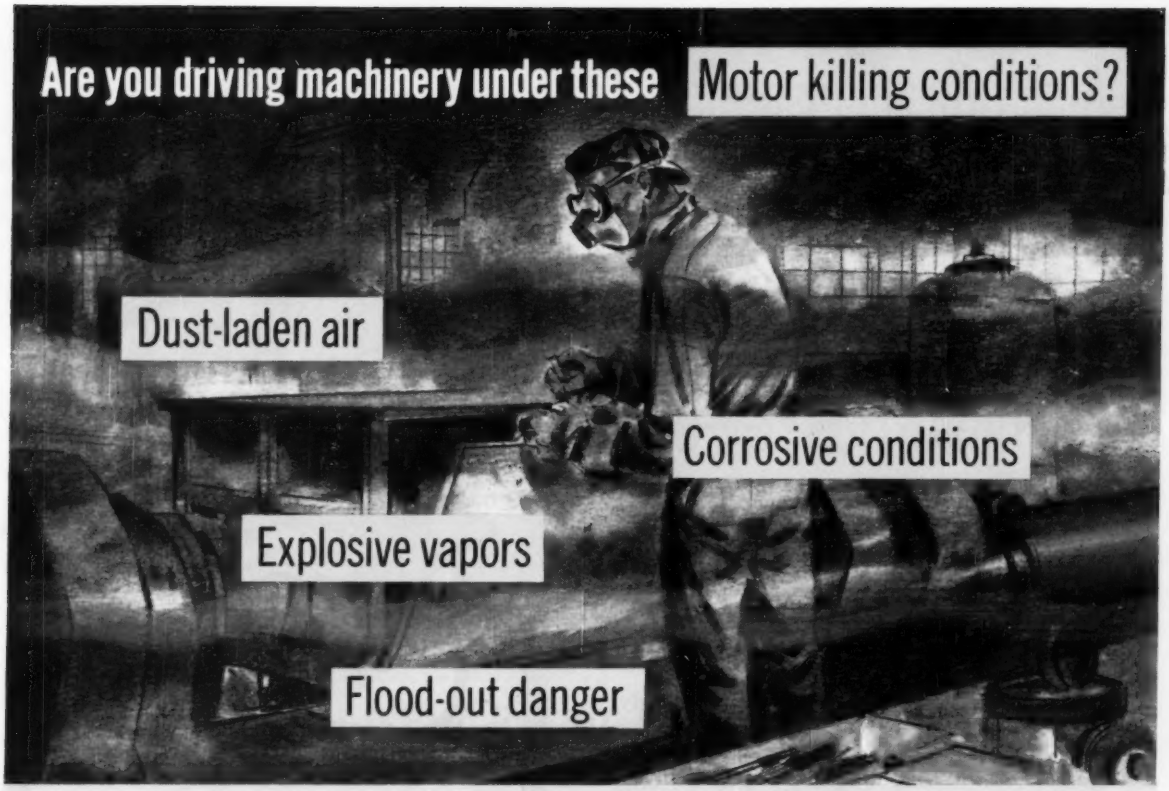

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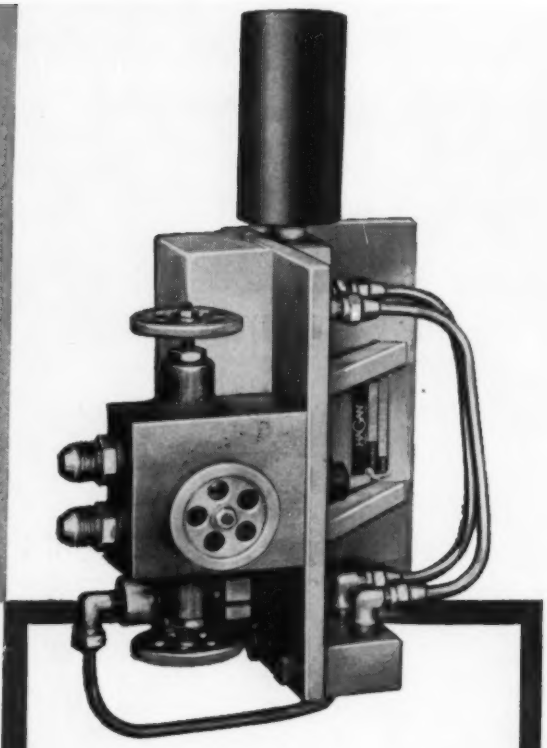

The Hagan Delta 'P' Transmitter is a sturdy, compact, force-balance instrument for pneumatically transmitting large pressure difference measurements. Consider these features:

1. No stuffing boxes, torque tubes or pressure-tight bearings.
2. Not affected by static pressure changes.
3. Usable at any static pressures up to 3000 psig.
4. Full scale pressure difference measuring ranges from 50 psi to 300 psi with 1% full scale accuracy.
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7. Stainless steel pressure elements, cadmium-plated steel frame.
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Pressure drop between boiler outlet and turbine throttle.

Pressure drop across high pressure heat exchangers.

Measuring pressure drop across liquid flow control valves for graduated control of pump discharge pressure.

As a "square root" flow meter when pressure differentials are higher than conventional flow meter design.

Measuring pressure differentials for alarm signal purposes under critical operating conditions, such as seal gas pressure during repair periods in a catalytic reformer unit.

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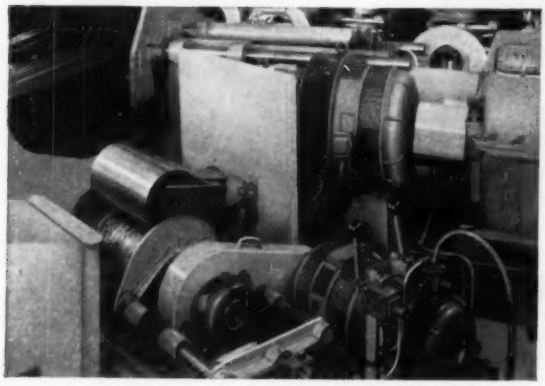
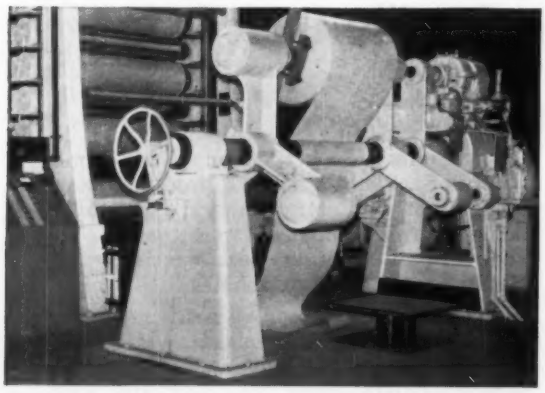


Metal slitter powered by Dynamatic Drives. Adjustable speed liquid cooled coupling used as main drive; Ajusto-Spede® Drives, with constant tension control, wind up the metal strips.



Completely Dynamatic driven paper super-calender. Adjustable speed liquid cooled couplings with Eddy-Current brakes drive the calender rolls and center rewinder. Dynamatic liquid cooled brake provides center unwind hold-back. Co-ordinated controls provide for wide-range adjustment of speed and tension.

Dynamatic Eddy-Current Drives with tension controls are used extensively in the fields of paper, rubber, textiles, ferrous and non-ferrous metals, plastics, and printing.

Combined with associated controls, Dynamatic Eddy-Current Drives provide automatic constant tension as the roll diameter changes on center rewinds and unwinds. Constant tension is maintained over a wide range of material delivery speeds without the use of dancer or follower rolls. Controls may be adjusted for tapered tension to increase or decrease tension automatically as the roll changes diameter.

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Bulletins giving detailed information on Dynamatic Tension Control will be sent free at your request.

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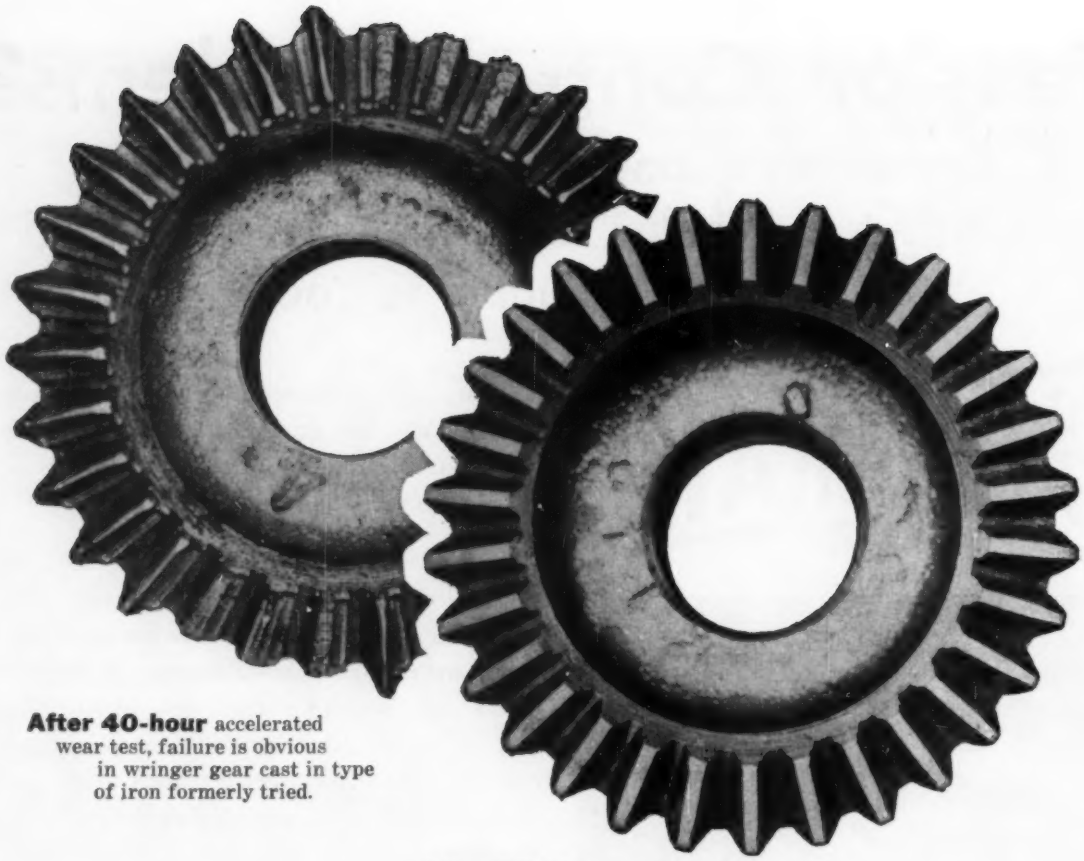

After 40-hour accelerated wear test, failure is obvious in wringer gear cast in type of iron formerly tried.

After 256 hours of identical testing, this Ductile Cast Iron gear shows distinctly superior resistance to wear.

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"Castability" of Ductile Iron spells volume output in St. Paul Foundry & Manufacturing Company, St. Paul, Minn., and in Jamestown Malleable Iron Company, Jamestown, N. Y., producers of wringer gear castings for Maytag home washing machines.

Try Ductile Cast Iron. Learn first-hand, how it outperforms other materials under tests and in service. Write now for a copy of the new booklet entitled, "DUCTILE IRON, THE CAST IRON THAT CAN BE BENT."

It's yours for the asking. We'll also send you the latest list of authorized foundries now producing Ductile Cast Iron under patent licenses. Write to INCO now.

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MARCH 1956

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MECHANICAL ENGINEERING

Heavy Presses Now in Production . . . . . *G. W. Motherwell* 214

Progress in Railway Mechanical Engineering—1954–1955 218

Science Changes the Scientist Too! . . . *G. E. Doan* 231

Difluorodichloromethane . . . . . *S. F. Murray, R. L. Johnson, and M. A. Swikert* 233

The Role of Technological Institutions in the Years Ahead . . . . . *J. T. Rettaliata* 237

The Engineer's Greatest Achievement . . *Crosby Field* 239

How Radiographic Inspection of Lead Linings Can Reduce Future Maintenance Costs . . . . . *W. Skiba and V. P. Bracken* 245

Editorial 213

Briefing the Record 248

World's Largest Shovel, 248; Interfloor Conveyer, 250; Convertible Freight Car, 250; Torque Control Impactool, 251; Tube-In-Strip Mill Products, 252; Air Conditioning, 254; Low-Voltage Wiring Device, 256; Robotester, 256; Titanium Industry, 257; Nuclear Briefs, 258; Experimental Automobiles, 258; General Motors Motorama (Photos), 260

European Survey 262

Los Peares Hydroelectric Station, 262; Flame Radiation From Pulverized Coal, 263; Hydrodynamic Research, 264

ASME Technical Digest 265

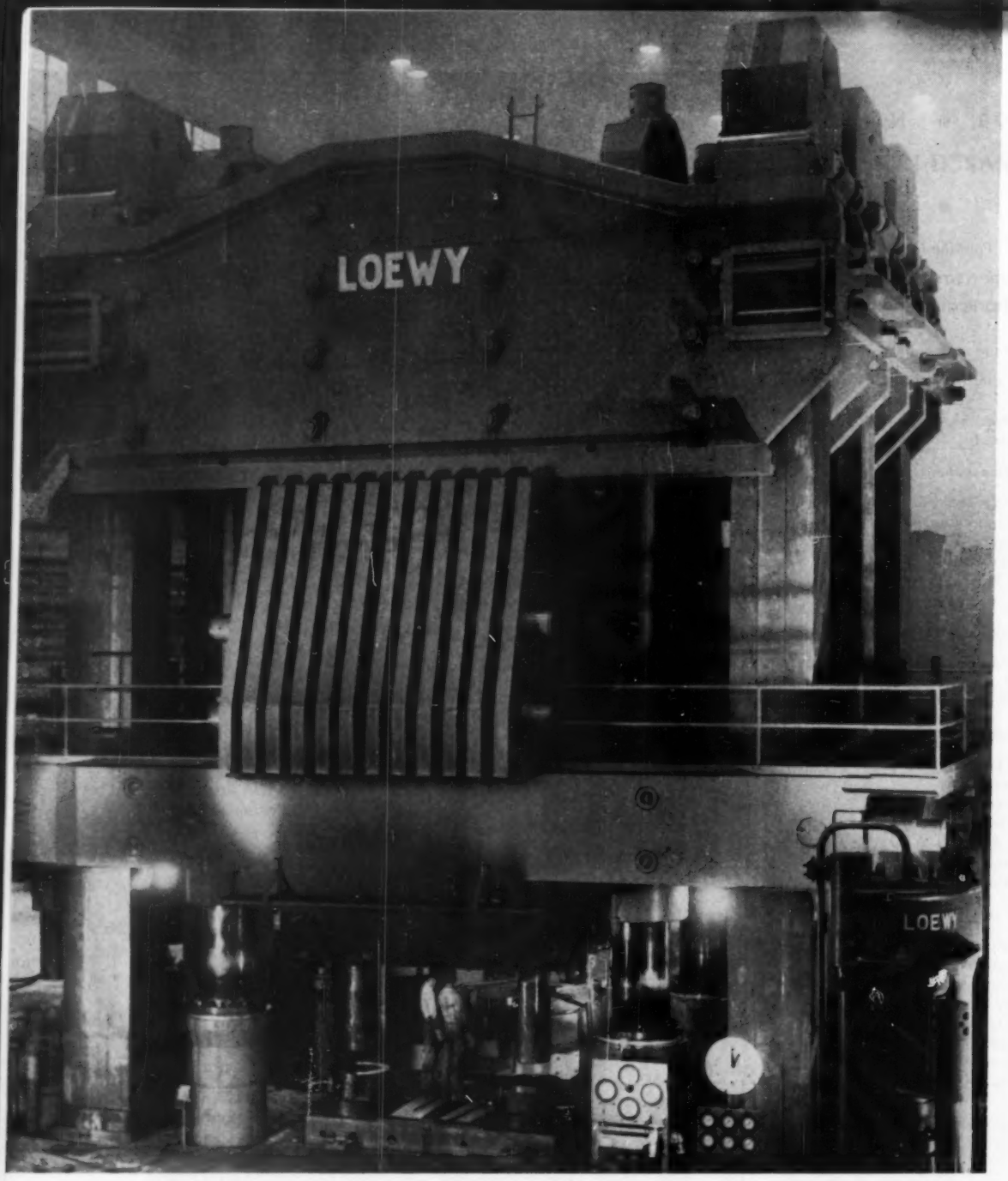
Steam Power Generation, 265; Boiler Feedwater Studies, 271; Fuels Technology, 271; Instruments and Regulators, 273; Gas Turbine Power, 273; Heat Transfer, 274; ASME Transactions for February, 1956, 275

Reviews of Books 276

ASME News 279

ASME Technology Executives Conference, 279; Applied Mechanics Conference, 284; ASME Student Conference, 284; ASME Coming Events, 285; GM Scholarship Plan, 285; L. K. Sillcox VPI convocation speaker, 285; ASME Membership, 285; American Power Conference, 286; ASME Nuclear Power Plants Meeting, 287; ASME Spring Meeting, 288; ASME Aviation Conference, 288; ASME Engineering Management Conference, 288; U. K. AEA Publications, 288; ASME Instruments and Regulators Conference, 289; Coming Meetings, 290; Meetings of Other Societies, 290; ASME Oil and Gas Power Conference, 291; ASME Gas Turbine Power Conference, 292; ASME Machine Design Conference, 293; ASME Metals Engineering Division, 294; ASME Seeks Nominees for Williston Award, 294; ASME Team Reports on Russia, 295; EJC General Assembly, 296; Junior Forum, 298; ASME Codes and Standards Workshop, 299; ASME Executive Committee Actions, 299; Personnel Service, 300; Candidates, 302; Obituaries, 304

Classified Advertisements 141 *Consultants* 164
Advertisers 166



U. S. Air Force Heavy Press Program . . .

. . . is now in operation at the Wyman-Gordon plant in North Grafton, Mass. This 50,000-ton forging press, designed and built by Loewy-Hydropress, is capable of exerting a pressure of 106,000,000 lb. Equal in height to an 11-story building, it stands 50 ft above the operating floor and descends 60 ft below it. The giant press is suspended in a 100-ft-deep pit, surrounded by walls of concrete and steel up to 17 ft in thickness. See pages 214 to 217.

Volume 78 • Number 3
MARCH 1956
•
George A. Stetson, *Editor*

MECHANICAL ENGINEERING

Meeting Deadline Dates

How is ASME trying to provide better service for its members? One important way is through its yearly Technology Executives Conference, the third of which was held Jan. 30–31, 1956, at the University of Michigan, at Ann Arbor, Mich. (See page 279 in this issue.) The purpose of these Conferences is to discuss problems relating to the Board on Technology and the Professional Divisions, Meetings, Publications, and Research Committees and to provide guidance to the committee members for their use during the year in carrying out the policies and aims of the Society.

In the main, the average ASME member is probably best acquainted with the periodical publications such as MECHANICAL ENGINEERING, Transactions of the ASME, and *Journal of Applied Mechanics;* pamphlet copies of papers which are available at the ASME Meetings; and the National Meetings or Division Conferences themselves.

Since technical papers originate with the Professional Divisions, Research, and other Committees, it was appropriate at this year's Conference for the Publications Committee to outline the importance of the Society's technical papers and its periodical publications, and discuss some of the problems they present. Special emphasis was placed on the deadline-date rule for receipt of papers for a specific meeting.

From its second Progress Report, dated Oct. 17, 1955, to the Board on Technology, the Publications Committee underscored the following suggestion with respect to deadline dates: "No papers will be assigned to Transactions unless manuscripts with illustrations, and recommendations of the sponsoring division or committee, are in the Editorial Department by the deadline date of the meeting at which the paper is to be presented, so that preprints from Transactions type can be prepared."

Enforcement of this deadline-date rule can contribute greatly to the success of any ASME Meeting. It should be obvious that a program with prepared pamphlet copies is an effective one, resulting in a better meeting, better discussion, and, of great importance, better service to members who are unable to attend the meeting, by making copies of the papers available to them.

Besides the inconvenience to members who are unable to obtain copies of papers of interest to them, failure to meet deadline dates places a double burden on the editorial staff and results in added costs when a paper that is finally published in Transactions has to be multilithographed for the meeting because it is received late or is incomplete.

If the paper is received before the deadline date, it can be set in type with copies for the meeting—the same type to be used later for publication in Transactions.

The question may arise as to why the deadline dates are set so far in advance of a meeting. (The complete paper with recommendation must be in the hands of the Editorial Department three months in advance of the first day of the month in which the meeting is scheduled.) It is the Editorial Department's function to take a raw manuscript, put it through its machinery, and end up with typeset or multilithographed copies for a meeting and ASME stock. When it is considered that some 650 papers must be processed during a year, all that is necessary (besides a good manuscript and original illustrations) is time.

Once a complete manuscript is received by the Papers Control Unit of the Editorial Department, many steps are involved before a pamphlet copy of the paper is completed. These include acknowledgment, records, assigning numbers, determining form of advance copies, editing, styling, photo layout, setting up type for the printed pamphlets or typing mats for the multilithographed copies, running the required number of copies of papers, notifying the author and divisions as to final disposition of the paper, and shipping copies to the hotel in advance of the meeting.

While the foregoing procedure is designed for a smooth flow of a paper through Papers Control, many delays arise because of failure to meet deadline dates. All such cases require individual attention and additional correspondence with divisions, committees, or authors.

The preparation of pamphlet copies for a meeting is a tedious and time-consuming task. It is a publishing job! And publishing anything, in particular technical papers, is an involved process. The end product must be a presentable package, free from errors, and a worthy contribution to the engineering field.

This can be accomplished by ASME, but the cooperation of the divisions, committees, and authors with regard to deadline dates is a vital factor. Preparation of papers in advance of the meeting, thus resulting in livelier and better discussion, a wider dissemination of technical information, and lower publications expense can be achieved by meeting deadline dates.—J.J.J., Jr.

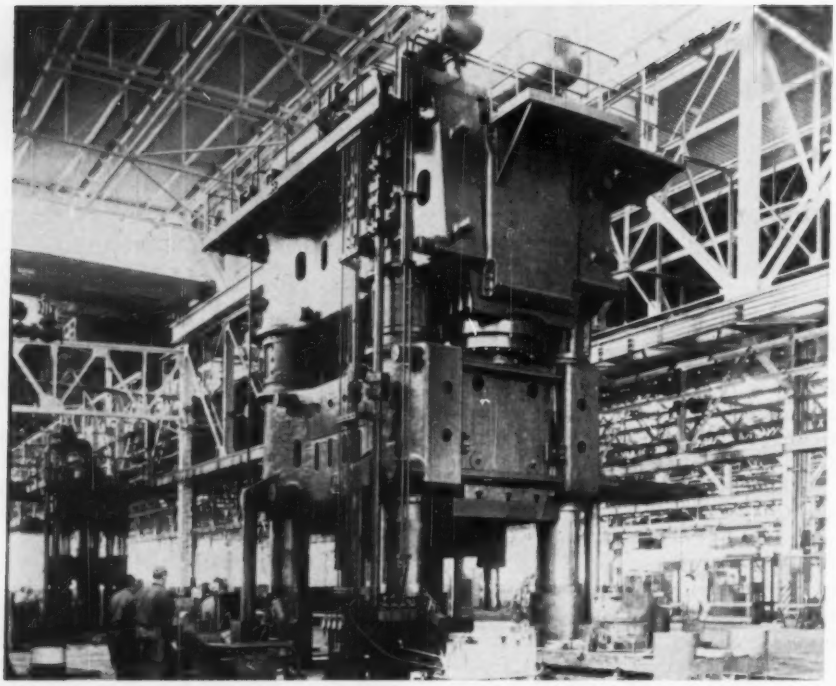


Fig. 1 16,500-ton German press, forerunner of USAF heavy-press program, operated by Bridgeport Brass at Adrian, Mich.

Heavy Presses Now in Production

50,000-ton die-forging presses turning out supersonic aircraft components

By George W. Motherwell

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As EARLY as World War I some thought was given to closed-die forging presses in the range of 8000 to 12,000 tons, but the first active suggestions for the design and construction of such presses were made in Europe about 1930. The main field for utilization was seen in war industries, which either directly or indirectly were under government subsidy.

First Heavy Presses

In the 1930's the tremendous build-up of war industry in Germany, together with necessary emphasis on available magnesium to replace scarcer materials wherever possible, resulted in the construction of several large closed-die forging presses just before World War II. The first 15,000-ton press in Germany was put into operation in 1938. In 1944 a 33,000-ton press was installed.

Heavy forging presses also were introduced in England during this period, as the demands of war industry dictated. In 1934 an order was placed with Schloemann by the British Air Ministry for a 15,400-ton press.

In France construction was begun in 1939 on a 22,000-ton press at Pamiers. It was intended primarily for aluminum propeller forging, but was not completed until after the war.

German Presses Dismantled. There were three 16,500-ton presses and one 33,000-ton press as well as a number of smaller presses in Germany at the end of World War II. Upon recommendation of a special mission to Germany in 1948, two of the 16,500-ton presses were dismantled and shipped to this country under Air Force sponsorship. One was re-erected at the Adrian, Mich., plant now operated by Bridgeport Brass (Fig. 1), and the other at the Alcoa, Cleveland Plant. The 33,000-ton press and the remaining 16,500-ton unit were dismantled by the Russians, shipped beyond the Ural

Contributed by the Aviation Division and presented at the Diamond Jubilee Annual Meeting, Chicago, Ill., November 13–18, 1955, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS. Condensed from original paper.

Mountains, and as far as is known, are still in successful operation there.

Development in the United States

While the wartime need for heavy forging presses was realized rather early in this country, no private industrial enterprise could justify investing its own money in the necessarily expensive installations. Credit must be given to the Supply Organization of the United States Air Force for recognizing the value of such a program and obtaining the necessary funds to finance this huge enterprise.

The first step was taken in 1944 when the Air Force and the War Production Board joined to initiate a Defense Plant Corporation project at North Grafton, Mass. This plant, to be operated by Wyman-Gordon Company, was planned around an 18,000-ton press, and began operation in April, 1946. It was intended first to produce large magnesium forgings, but soon an increasing portion of its activity was in newly designed large aluminum forgings also.

In the summer of 1945 a group of industrial experts was sent to make a detailed study of the heavy hydraulic forging and extrusion presses there. The completion of the North Grafton Plant coincided with the final report of the Strategic Bombing Survey on these investigations in Germany. Their findings reinforced previous information and further encouraged the steps under way here. Particularly in magnesium it was re-emphasized that high constant pressures were more desirable than hammer blows.

The success of the hydraulic die-forging press at North Grafton together with this information on European experience aroused interest in further potentials of heavy die-forging. It was felt that 35,000 and 50,000-ton units should be put in operation, and experience from them used in evaluating any next step to be taken in the program.

The Heavy-Press Program. In 1949 the National Security Resources Board asked a recognized authority on the plastic forming of metals to survey facilities in this country, and as a result of this study the Munitions Board called a series of meetings in the early summer of 1950. They agreed upon a program of construction and gave the Air Force complete responsibility for seeing the job through. Thus was born what we now know as the "Air Force Heavy Press Program." The original allocation of presses is given in Table 1.

Table 1 Proposed USAF Heavy-Forging-Press Program—1952

Operator	Press rating, tons	Press builder
Alcoa, Cleveland, Ohio	1–50000	Mesta
	1–35000	United
Harvey Machine, Torrance, Calif.	1–35000	United
	1–25000	Baldwin Southwark
Kaiser Aluminum, Newark, Ohio	1–35000	Bliss
	1–25000	Bliss
Wyman-Gordon, North Grafton, Mass.	1–50000	Loewy
	1–35000	Loewy

This program was reviewed once more in the summer of 1953, which resulted in some cutbacks. The large forging presses were eliminated from the Harvey and

Fig. 2 35,000 and 50,000-ton presses operated by the Aluminum Company of America at the Cleveland Plant

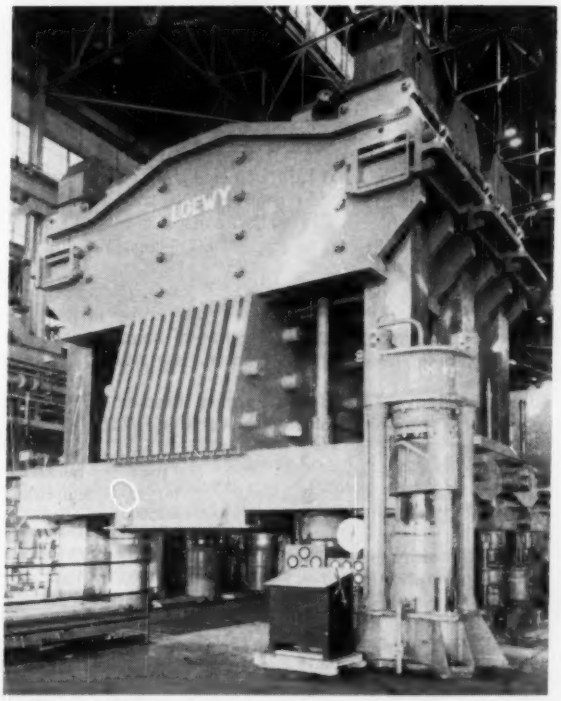

Fig. 3 50,000-ton press built by Loewy and operated by Wyman-Gordon at the North Grafton, Mass., plant

Fig. 4 Delta-wing spar forging for supersonic, all-weather interceptor, Convair F-102

Kaiser installations, but their original extrusion presses were retained.

Alcoa Installation. The Alcoa, Cleveland, installation was built adjacent to the existing plant. It covers some 12 acres under roof and houses one 50,000-ton hydraulic closed-die forging press built by Mesta, and one 35,000-ton press built by United Engineering and Foundry Company. These presses went into operation in May, 1955. A view of the plant is shown in Fig. 2.

Wyman-Gordon Installation. The Wyman-Gordon installation under this program added a 50,000-ton press (Fig. 3) and a 35,000-ton press to the original press plant at North Grafton. These two presses were designed and built by Loewy Construction Company. The expanded plant, somewhat larger in size than the Cleveland installation, covers approximately 21 acres under roof including the office. The 35,000-ton press began operation in February, 1955, and the 50,000-ton press in October, 1955.

All forging presses of the USAF program have been installed and are in operation. Including units previously operating, the complete list of heavy closed-die forging presses in use in this country is given in Table 2.

Table 2 Heavy Closed-Die Forging Presses[a] Operating in the United States—November, 1955

Operator	Press rating, tons	Press builder
Alcoa, Cleveland	1-15000	Schloemann
	1-35000	United
	1-50000	Mesta
Bridgeport Brass, Adrian, Mich.	1-15000	Schloemann
Wyman-Gordon, North Grafton, Mass.	1-18000	Mesta
	1-35000	Loewy
	1-50000	Loewy

[a] 15,000 tons rating and over.

Current Forgings

Use of heavy-press die forgings from their inception through the present time has been largely in aircraft,

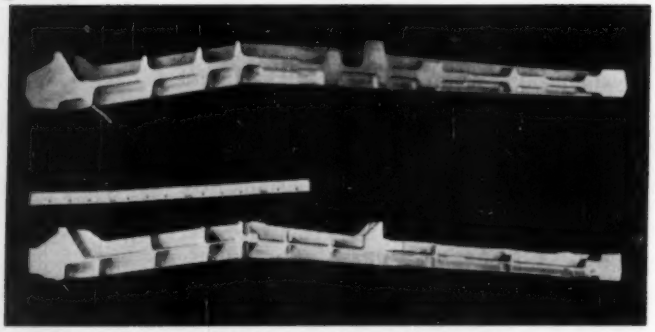

Fig. 5 Cross sections of conventional and reduced-draft, close-tolerance forgings

and this appears likely to continue in the foreseeable future. Some other applications have been made, and great effort is devoted by the press operators to develop the maximum potential of this equipment in all fields. Each new application in any field provides valuable experience for improving its effectiveness for all.

Nevertheless, the prime mission of the Heavy Press Program is the advance of aircraft design. New supersonic high-performance aircraft require the greatest possible structural strength, with weight and bulk held to a minimum. These new forging and extrusion presses make possible the necessary structures, with high strength-to-weight ratio, at low cost and in production quantities. The presses have already proved that this can be accomplished.

The first forging from a 35,000-ton press is the wing spar for a delta-wing, all-weather, supersonic interceptor for the Air Force (Fig. 4). The forging is 10 ft 6 in. long and 18 in. wide with webs $^{3}/_{16}$ in. thick. There are four forgings per airplane. They replace 272 pieces and 3200 rivets that would have been needed under previous types of construction. They also save approximately 100 lb of aluminum per airplane.

Fig. 5 shows cross sections of a conventional forging, and a reduced-draft, close-tolerance forging with thin web sections now in production. This interim forging saves approximately 20 per cent in machining cost, as well as approximately 25 per cent in material.

Fig. 6 shows another forging in which considerable machining and weight are saved by the minimum-draft, close-tolerance design.

Again, in the forging shown in Fig. 7, machining and material requirements were reduced by the press-extruded-forging technique. Also, superior physical properties resulted which were not available in the equivalent conventional forging.

Fig. 8 shows a press-extruded forging together with the conventional forging it replaces. It saves approximately 30 lb of forging stock. Only 2 lb of material are machined from it before assembly compared with the 23 lb machined off the conventional forging.

Progress Through Co-Operation

Neither presses nor forgings are ends in themselves. They are useful only as they help improve end products which contribute to a stronger peace economy or a more effective defense machine.

The suppliers of forging stock are carrying on their

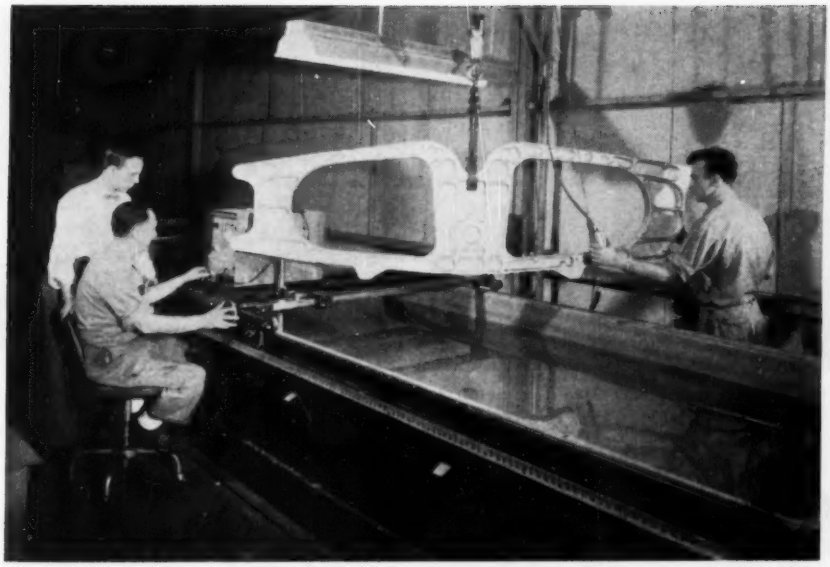

Fig. 6 Fuselage-frame forging for Republic F-105, being readied for ultrasonic inspection

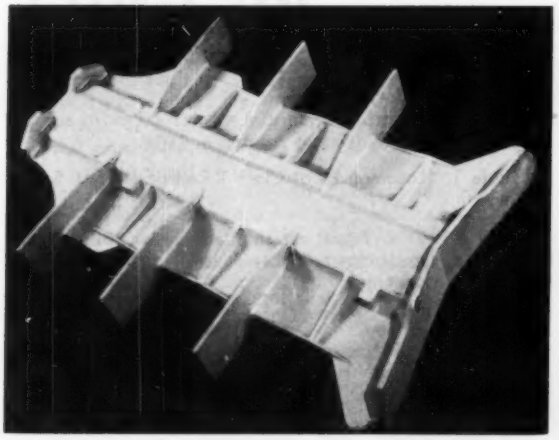

Fig. 7 Showing press-extruded rib-chord forging for Boeing KC-135

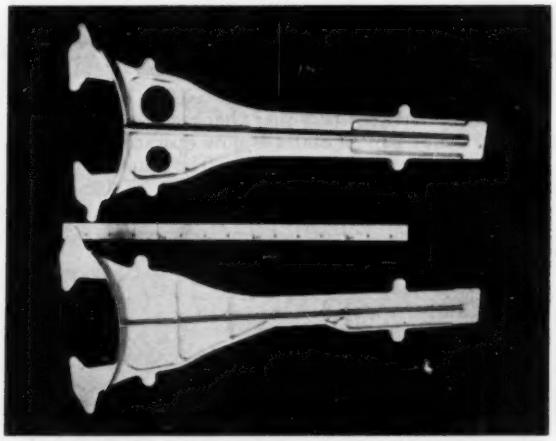

Fig. 8 Press-extruded support forging (*lower*) for McDonnell F-101, and conventional forging it replaced

work toward improved forging alloys and preparation of forging stock to provide ever better properties, forgeability, and machinability.

Changes in materials, equipment, processes, and designs demand greater co-operation and mutual understanding all along the line. It can be reported that this understanding is growing, and with it a continuing increase in progress toward the common goal of better aircraft produced more efficiently.

Conclusion

Enough time has elapsed and experience gained to prove that the United States Air Force Heavy Press Program is worth while in every respect. The tremendous strides, which already have been made in the short time these machines have been available, encourage the belief that we are only on the threshold of their potential possibilities. Continued collaboration on current problems and a continual accretion of knowledge and experience insure success.

Acknowledgments. The author gratefully acknowledges the helpful assistance of the United States Air Force, Loewy Construction Company, Aluminum Company of America, and Bridgeport Brass, as well as his colleagues at Wyman-Gordon Company. Individual acknowledgment, particularly to Hugh Dean, Alexander Zeitlin, Don Welty, Arthur Lowery, and the authors of many articles and papers, written on the subject of the heavy presses.

Fig. 1 Rectifier-type locomotive for 25,000-volt single-phase operation by French National Railways

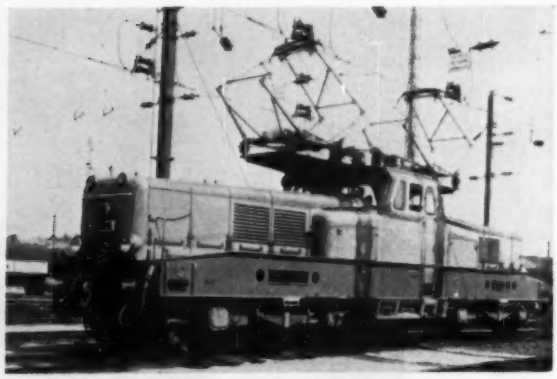

Fig. 2 Electric locomotive for operation on newly electrified line of French National Railways

Progress in

Railway Mechanical Engineering —1954-1955

It can be reported this year that every major Class I railroad in the United States is now operating or has on order diesel-electric locomotives. The number of steam units continues to decline significantly. Table 1 indicates the distribution of motive-power types in service on domestic railroads as of August 1, 1955.

Table 1 Locomotives of Class 1 Railroads of U. S.[a]

	Diesel	Steam	Electric	Gas turbine	Steam turbine	Total
Units owned or leased	24348	7047	666	25	1	32087
Units stored serviceable	9	1079	15	0	0	1103
Units awaiting repair	843	1228	90	0	0	2161

[a] AAR-C556A—557.

Report of Committee RR-6 Survey: Chairman, D. R. Meier; members, F. A. Benger, R. M. Coultas, and F. L. Murphy.

Contributed by the Railroad Division and presented at the Diamond Jubilee Annual Meeting, Chicago, Ill., November 13–18, 1955, of The American Society of Mechanical Engineers.

Note: The survey covers the period September 1, 1954, to September 1, 1955.

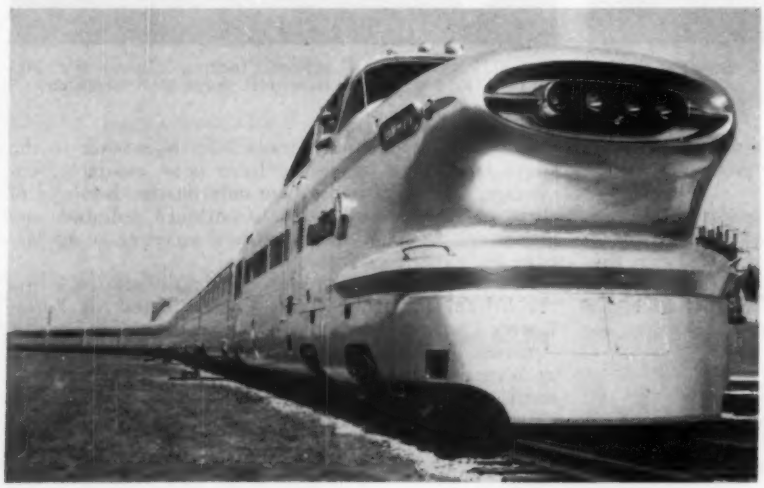

Fig. 3 GM-built 1200-hp locomotive with train for use in high-speed passenger service

The number of diesels owned or leased increased by 871 units in the 12-month period preceding August 1, 1955. Many railroads, already dieselized, have ordered additional units to handle the sharply increased traffic being experienced by the American railroads. The number of steam locomotives actually working declined by over 1000 during the same period.

The trend toward more universal or all-purpose-type cabs, noticeable both in this country and abroad, seems to be continuing.

No significant improvement in horsepower/weight ratio of locomotives was reported during the current year. There continues to be a wide difference between foreign and domestic locomotives in terms of horsepower/weight ratio. Foreign manufacturers are apparently using lighter-weight mechanical structures, and in some cases higher-speed, lighter-weight engines. Though electric drive predominates, hydromechanical-drive developments continue with major activity among foreign manufacturers, but with some increased attention shown by domestic manufacturers and railroads.

Domestic Diesel-Electrics Highly Standardized

The small number of domestic diesel-electric locomotives reported reflects the extent to which standardization has been established, and also indicates a minimum of model changes in these standards. The disproportionate amount of space given in this report to other forms of motive power tends to obscure the dominant position of the diesel—particularly in America. This is explained by the high degree of standardization attained by the manufacturers of diesel-electrics which has permitted highly repetitive manufacturing of a relatively small number of locomotive designs which have been covered in previous reports of this Committee.

The development of the rectifier-type electric locomotive continues, particularly in France and the United States. The delivery of ten rectifier locomotives to the N.Y., N.H., & H. R.R., and the order for twelve locomotives for the Virginian Railway are evidence of increasing interest in this type of power-conversion system for locomotives in this country.

The French National Railways has on order or in operation a total of 52 B-B ignitron-rectifier locomotives for its 25,000-volt 50-cps electrification (1).[1] The French have concluded that the rectifier-type locomotive is superior to the series-commutator type, and also that the 50-cps system is superior to $16^2/_3$ cps.

It was reported last year that an electric locomotive of the French National Railways had set a world railway speed record of 150.9 mph. A new record of 207 mph was established by the same system in March, 1955. This speed was attained by a C-C locomotive (2) and also by a B-B locomotive (3), each pulling three passenger cars. The locomotives developed 12,000 hp at maximum speed.

The French National Railways began operation of electric locomotives over a new section of line electrified at 25,000 volts, 50 cps (4). It is reported that an ore-train run of 170 miles which formerly required almost 5 hr now requires a little over 3 hr. On this line, 300 steam locomotives will be replaced with 100 electric locomotives. Two new locomotives designed for service

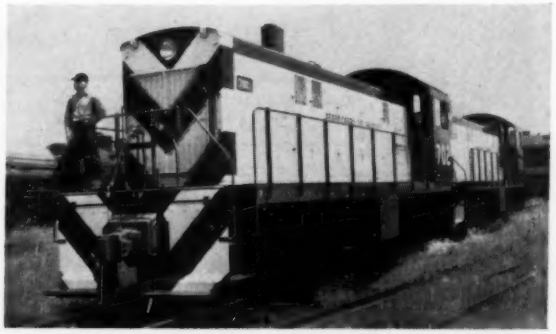

Fig. 4 Alco 900-hp diesel-electric switching locomotive

Fig. 5 Baldwin-Lima-Hamilton hydraulic-drive switching locomotive for United States Army

Fig. 6 German-built 2000-hp, 86-ton, hydraulic-drive locomotive for German Federal Railways

on this line are described under items 5 and 6 of Table 4, and Figs. 1 and 2.

The British Railways announced a long-range program of modernization, to cost an estimated $3.5 billion, and involving improvements in motive power, passenger and freight cars, signal systems, tracks, and so on. The program, expected to require 15 years for completion, involves replacing 19,000 steam locomotives with diesel and electric locomotives. Contracts for approximately $100,000,000 worth of equipment already have been awarded (5).

An agreement for the study of a nuclear-power reciprocating engine was made by the Baldwin-Lima-Hamilton Corporation, and the Denver and Rio Grande Western Railroad. The study will include the technical as well as economic aspects of such an engine. Atomic Energy Commission personnel will furnish con-

[1] Numbers in parentheses refer to the Bibliography at the end of the paper.

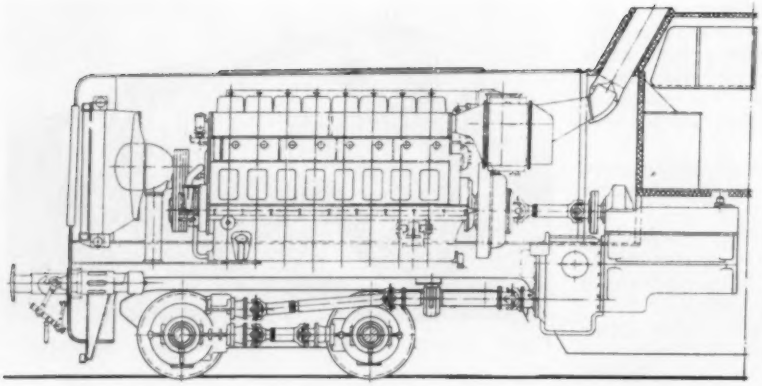

Fig. 7 Partial section of 86-ton hydraulic-drive German locomotive shown in Fig. 6

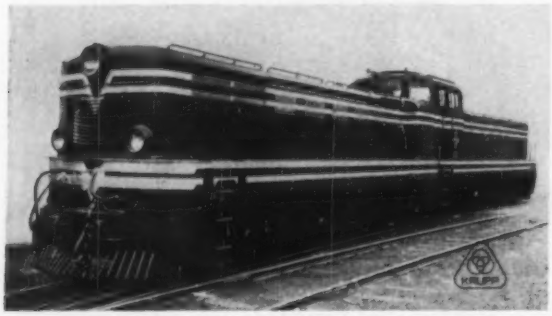

Fig. 8 B-B-B hydraulic-drive locomotive built by Krupp for service in Brazil

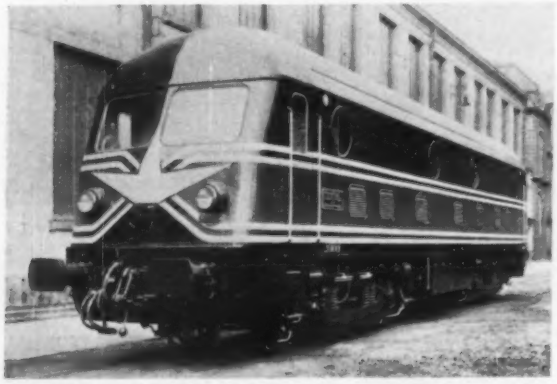

Fig. 9 93-ton, 1750-hp diesel-electric locomotive for Belgian National Railways

sultation and assistance. A report is to be made to the AEC after a year of study (6).

Gas-Turbine Locomotives

The 25 gas-turbine-electric locomotives owned by the Union Pacific Railroad continue to operate successfully on residual fuel oil. These locomotives have accumulated a total of 4,800,000 miles of operation.

The magazine "Bituminous Coal Research" (6) reports the following on coal-burning gas turbines:

"The 1955 tests (Jan. 15 to April 2) have shown that the coal-burning gas turbine can carry full rated load for long periods of operation on both high and low-volatile coal. The average specific coal rate was slightly below one pound of coal per horsepower hour, giving a thermal efficiency of 20.8 per cent.

"Study of the problems of gas-turbine locomotive-fuel supply led the Sub-Committee on Coal Supply and the L.D.C. Staff to conclude that the use of $^{3}/_{16} \times 0$ dried coal would be highly advantageous from the standpoints of availability and low price. The coal system which is currently under development will use an aerated bunker to discharge the coal directly into the rotary coal pumps. Conveying air from the main compressor will carry the coal to a pressurized attrition mill, from which the coal, now pulverized, will be delivered immediately to the combustors."

Table 2 Diesel Locomotives Manufacturers in the United States

Item no.	1	2	3
Builder—mechanical	GM	ALCO	BLH
Builder—electrical	GM	GE	—
Owner	GM	Various	U. S. Army
Service	Pass.	Switch	Switch
Wheel arrangement	B-1	B-B	B-B
Engine data:			
Engines per cab	1	1	1
Hp ratings per engine (*a*)	1200	900	400
No. of cylinders	12	6	12
Bore and stroke, in.	$8^{1}/_{2} \times 10$	$9 \times 10^{1}/_{2}$	$5^{3}/_{4} \times 8$
Engine speed, rpm	835	1000	1200
Cycles	2	4	4
Supercharging	Yes	Yes	—
Manufacturer	GM	ALCO	Cat.
Weight on drivers, lb	—	230000	104000
Total locomotive weight, lb	—	230000	104000
Fuel capacity, gal	—	635	350
Driving-wheel diameter, in.	—	40	40
Type of transmission	Elec.	Elec.	HM
Track gage, in.	$56^{1}/_{2}$	$56^{1}/_{2}$	$56^{1}/_{2}$–66
Maximum speed, mph	102	60	35
Fig. no.	3	4	5

GM—General Motors.
ALCO—Alco Products, Inc.
BLH—Baldwin-Lima-Hamilton Corp.
HM—Hydromechanical.
GE—General Electric Company.
Cat.—Caterpillar Tractor Company.
(*a*)—Engine hp is net hp for traction use.

Diesel Locomotives

A diesel-electric locomotive designed especially for service on lightweight, high-speed, passenger trains is shown in Fig. 3, and is listed under item 1, Table 2. This locomotive has a standard four-wheel truck at the front, and one idle axle at the rear of the locomotive (7).

A new model switching locomotive was announced by Alco Products, Inc. (item 2, Table 2). It features the

company's new 251 series diesel engine. Fig. 4 is a photograph of the locomotive.

An experimental diesel-mechanical locomotive with hydraulic torque converter has been built for the U. S. Army Transportation Corps. It is the first American-built locomotive to use the Mekydro transmission, which has been used successfully in Europe (9). The locomotive is now being tested in general switching service at the Baldwin-Lima-Hamilton plant at Eddystone, Pa. It is shown in Fig. 5 and is described under item 3, Table 2.

Twenty 2000-hp locomotives with hydraulic drive are being placed in service in Germany. These locomotives have a power/weight ratio of 23 hp per ton. Fig. 6 illustrates one of these locomotives, which is further described under item 1, Table 3. A sectional drawing of one end of the locomotive, which is symmetrical, is shown in Fig. 7.

A German-built hydraulic-drive locomotive of 2000 hp, designed for heavy freight service, is described under item 2, Table 3. The Krupp transmission features individual axle drive through six torque converters. Three transmissions are combined in one housing from which drives extend to the end axles and one of the center axles. The locomotive is shown in Fig. 8.

The Belgian National Railways is taking delivery of 55 locomotives designed for main-line service and manufactured by S. A. John Cockerill (item 3, Table 3). Though the engine used is of low speed and relatively

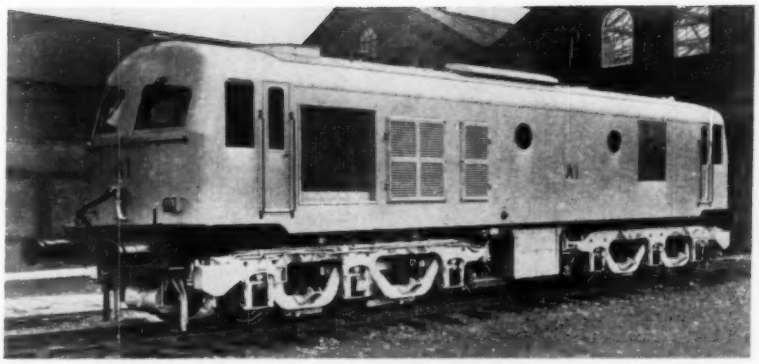

Fig. 10 British-built diesel-electric locomotive constructed for the Irish Railways

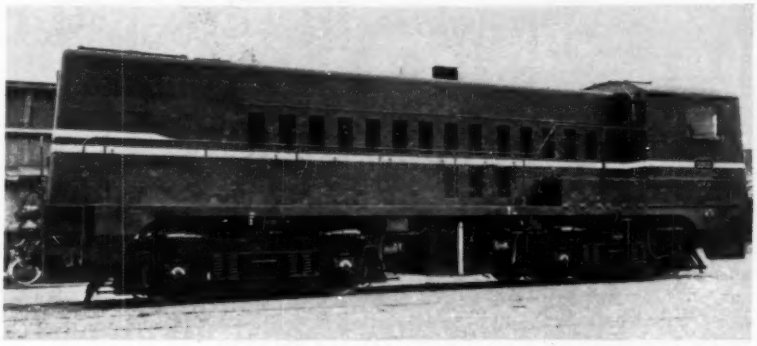

Fig. 11 1900-hp locomotive for freight and switching service on Netherlands Railways

Table 3 Diesel Locomotives of Foreign Manufacture

Item no.	1	2	3	4	5	6
Builder—mechanical	Mak	Krupp	Cockerill	Metro-Vick	Allan	No. Br.
Builder—electrical	—	—	ACEC	Metro-Vick	Heemaf	—
Owner	German	Brazil	SNCB	CIE	Holland	Indian Gov't.
Wheel arrangement	B-B	B-B-B	B-B	C-C	B-B	B-B
Service	F&P	F&P	F&P	F&P	F&S	F&P
Engine data:						
Engines per cab	2	2	1	1	1	1
Engine hp rating	1000	1000	1750	1200	900	625
No. of cylinders	8	8	8	8	8	12
Bore and stroke, in.	9.06 × 11.83	8.67 × 11.83	12 3/8 × 15 1/2	10.5 × 13.5	8.5 × 10.5	7 × 7 3/4
Engine speed, rpm	750	900	625	625	1100	1250
Cycles	4	4	4	2	4	4
Supercharged	Yes	Yes	Yes	—	Yes	Yes
Manufacturer	Mak	Man	Cockerill	Crossley, Ltd.	Stork	Paxman
Weight on drivers, lb	171600	211000	185000	190000	158000	96000
Total locomotive weight, lb	171600	211000	185000	190000	158000	96000
Fuel capacity, gal	750	1240	600	500	580	600
Driving-wheel diameter, in.	37 1/2	37 1/2	44	38	37 1/2	34
Type of transmission	Hyd.	Hyd.	Elec.	Elec.	Elec.	Hyd.
Track gage, in.	56 1/2	56 1/2	56 1/2	63	56 1/2	39 3/8
Maximum speed, mph	87	50	75	75	62	55
Fig. no.	6, 7	8	9	10	11	12

F = Freight, P = Passenger, S = Switching.
Mak—Maschinebau Kiel Aktiengesellschaft.
German—German Federal Railways.
Krupp—Fried. Krupp Lokomotivfabrik, Germany.
Brazil—Companhia Vale do Rio Doce, Brazil.
Man—Maschinenfabrik, Augsburg, Germany.
CIE—Irish Transport Company.
Heemaf—Holland (see note).
Holland—Netherlands Railways.
No. Br.—North British Locomotive Co., Ltd.
Paxman—Davey Paxman & Co. Ltd., England.
Cockerill—S. A. John Cockerill, Belgium.
ACEC—Ateliers de Constructions Electriques, Belgium.
SNCB—Belgium National Railways.
NOTE: Identical locomotives will be built in France by Schneider le Crevoot, who will build electrical and mechanical equipment, and engine.

Table 4 Electric Locomotives

Item No.	1	2	3	4	5	6	7	8	9	10
Railroad	NY NH & H[a]	NYC[b]	R.A.B.B.[c]	Austrian[d]	SNCF[e]	SNCF	Turkey[f]	J.N.R.[g]	J.N.R.	Swedish[h]
Builder—mechanical	GE	ALCO	Henschel	Simmering	Creusot	Creusot	Alsthom	Hitachi	Hitachi	Nydquist-Holm
Builder—electrical	GE	GE	Siemens	Brown Boveri	SW	Jeumont	Jeumont-sw	Hitachi	Hitachi	Swedish GE
Wheel arrangement	C-C	2-C + C-2	B-B	C-C	B-B	B-B	B-B	B-B + B-B	B-B	B-B
Service	P	P	F	P	F&P	F&P	F&P	F	F&P	F&P
Power supply	11 kv 25 cps	600 V d-c	6 kv 50 cps	15 kv 16⅔ cps	25 kv 50 cps	25 kv 50 cps	25 kv 50 cps	1590 V d-c	20 kv 50 cps	15 kv 16⅔ cps
Power conversion	Ignitron rec.	—	Motor-gen.	A-C series mot	Ignitron rec.	A-C series mot	A-C series mot	—	A-C series mot	A-C series mot
Current collector	Panto	3rd rail	Panto	Panto	Panto	Panto	Panto	Panto	Panto	Panto
Driving wheels:										
Number	12	12	8	12	8	8	8	16	8	8
Diameter, in.	40	48	44	51	49	49	53	49¼	49¼	51
Weight, lb:										
Total	348000	388000	265000	231000	185000	185000	176400	256000	123000	137600
On drivers	348000	288000	265000	231000	185000	185000	176400	256000	123000	137600
Per driving axle	58000	48000	66000	38600	46250	46250	44100	32000	30800	34400
Dimensions, ft-in.										
Length over-all	68-0	80-0	47-7	58-7	49-9	49-9	53	73-10	44-4	49-7
Width over-all	10-5⅜	10-0⅞	9-10	10-9	9-6	9-6	9-2	9-2	9-2	10-5
Height, panto down	14-8¼	14-8¼	14-5	15-2	14	14	13-1	13	13-5	14-9
Rigid wheelbase	15-0	15-0	10-2	13-6	10-6	10-6	9-9	10-2	8-8	9-6
Total wheelbase	52-6	69-0	30-10	41-9	36-6	36-6	34-2	60-9	29-5	35-1
Traction motors:										
Number	6	6	4	6	4	4	4	8	4	4
Method of mounting	Axle-hung	Axle-hung	Axle-hung	Spring	Suspended	Suspended	Suspended	Axle-hung	Axle-hung	Suspended
Method of drive	Gear	Gear	Gear	Quill	—	—	Quill	Gear	Gear	Cardan shaft
Gear ratio	1/3.84	1/3.35	1/5.64	1/3.185	19/73	25/73	1/4.93	21/77	16/93	30/83
Tractive force, lb:										
One-hour rating	34100	46200	47400	35200	39700	29900	23000	40550	—	16300
Per cent adhesion	9.8	16.0	17.9	15.2	—	—	13	15.9	—	11.85
Continuous rating	34100	40800	38600	26800	35300	29900	20700	24250	19850	—
Per cent adhesion	9.8	14.2	14.6	11.6	—	—	11.75	9.5	16.1	—
Rail horsepower:										
One-hour rating	4000	4670	1920	5250	3440	2630	2320	3340	—	2870
Continuous rating	4000	4230	1610	4440	4440	2630	2140	2260	1220	—
Speed, mph:										
One-hour rating	44	38	15.2	56	32.5	33	37.8	30.9	—	66
Continuous rating	44	39	15.65	62	33.5	33	38.8	35	23	—
Maximum	90	70	43.5	81	75	65	56	51.5	43.5	93
Regeneration	No	No	Yes	No	No	No	No	No	No	No
Multiple-unit operation	No	No	Yes	No	No	No	No	No	No	No
Track gage, in.	56½	56½	56½	56½	56½	56½	56½	42	42	56½
Fig. No.	13, 14	15	16	17	1	2	18, 19	20	21	22

[a] New York, New Haven & Hartford.
[b] New York Central Railroad.
[c] Rhine Lignite Corporation at Cologne.
[d] Austrian Federal Railways.
[e] French National Railways.
[f] Turkish State Railways.
[g] Japanese National Railways.
[h] Swedish State Railways.

heavy, the manufacturer was able to minimize total weight through the use of careful mechanical-design procedures. A photograph of one of the locomotives is shown in Fig. 9.

Sixty 1200-hp locomotives (item 4, Table 3) have been ordered from Metropolitan Vickers for Coras Iompair Eireann (Irish Transport Company). These locomotives represent a major step in the changeover from steam to diesel traction on the Irish Railways. One of them is illustrated in Fig. 10.

A total of 150 900-hp locomotives (item 5, Table 3) for the Netherlands Railways is being built under license of Baldwin-Westinghouse - Superior. One hundred of these are being built in Holland and the remainder in France. They are designed for freight and switching service. Fig. 11 shows one of the locomotives.

Twenty 625-hp diesel-hydraulic locomotives for the Indian Railways were built by North British Locomotive Company Ltd. (Fig. 12). These locomotives (item 6, Table 3) are of meter gage and are used for passenger and freight service.

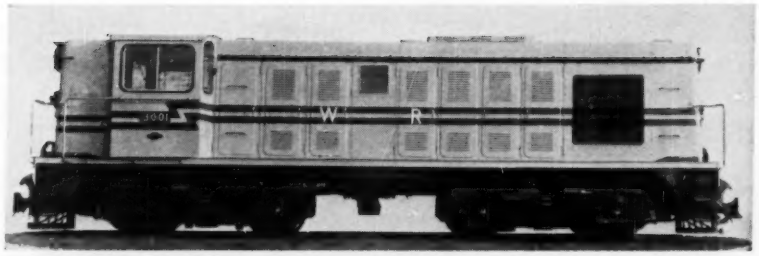

Fig. 12 625-hp diesel-hydraulic locomotive built in Scotland for Indian Railways

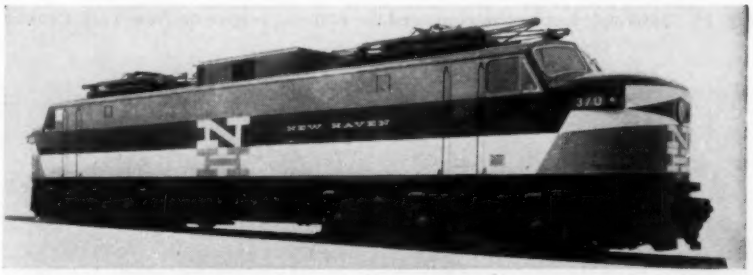

Fig. 13 One of ten 4000-hp electric locomotives for New Haven Railroad

Electric Locomotives Here and Abroad

Among the electric locomotives placed in service during the past year are the 10 units delivered to the N.Y., N.H. & H. R.R. by General Electric (10). These are equipped with a standard d-c traction motor of the type used on diesel-electric locomotives. Power is supplied from a 11,000-volt 25-cps single-phase system, and converted by ignitron rectifiers. The locomotives are designed so that when they are in the Grand Central Terminal zone of the New York Central Railroad they operate from the 600-volt d-c third rail. A photograph of one of these units with its striking black-white-red color scheme is shown in Fig. 13, while principal data concerning it are given under item 1, Table 4. Longitudinal elevation and plan showing equipment layout are depicted in Fig. 14.

Twenty locomotives built in 1930, and originally designed for operation on 3000 volts d-c at Cleveland, are being modernized and converted to operate on the 600-volt third-rail system of the New York Central Railroad in the Grand Central Terminal zone district just mentioned. These locomotives are described under item 2, Table 4, and illustrated in Fig. 15.

An electric locomotive intended for use in heavy-duty mining service on an industrial-frequency electrification is shown in Fig. 16 and described under item 3, Table 4.

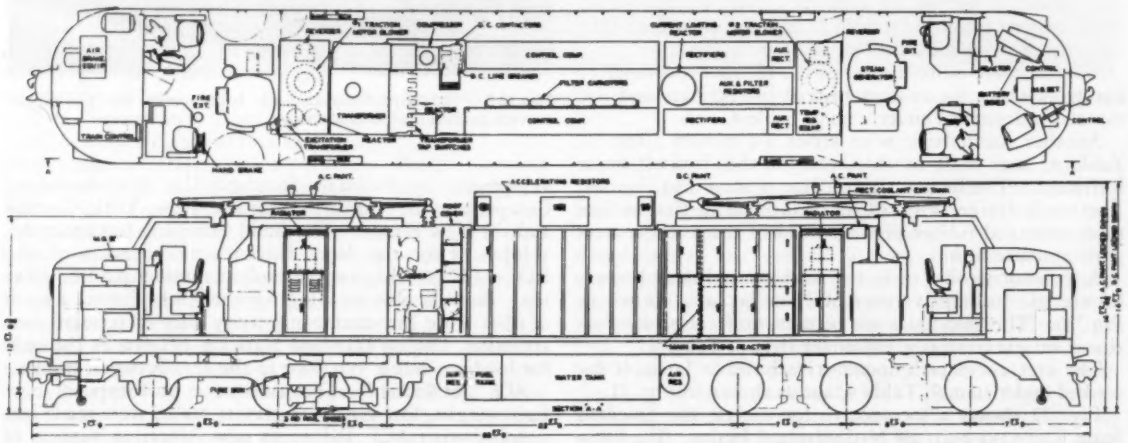

Fig. 14 Elevation and plan of new locomotive for New York, New Haven and Hartford Railroad, shown in Fig. 13

Fig. 15 3000-volt locomotive converted for 600-volt service on New York Central

Fig. 16 Commercial frequency motor-generator locomotive designed for heavy-duty industrial-haulage service

Although this is a motor-generator locomotive, it is of interest to note that three similar locomotives which will use rectifiers for power conversion are under construction by the same builder.

The Austrian Federal Railways placed in passenger-service the high-powered electric locomotive shown in Fig. 17, and described under item 4, Table 4. This new locomotive runs from Vienna to the Swiss frontier (47 miles) crossing two mountain ranges and encountering grades of 3.2 per cent maximum.

A rectifier-type locomotive designed for use in freight and passenger service on a newly electrified section in Northeastern France is shown in Fig. 1. Principal data concerning it are tabulated under item 5, Table 4.

A locomotive quite similar to the rectifier locomotive, but with series a-c motors instead of rectifiers and d-c motors, is described under item 6, Table 4.

Another locomotive with series a-c motors (item 7, Table 4) was built by Alsthom for the Turkish State Railways. The locomotive outline is shown in Fig. 18. The truck design, Fig. 19, is of interest in that it features a conical rubber pivot instead of the usual center-plate construction.

A locomotive said to be the heaviest and most powerful electric locomotive ever built in Japan is shown in Fig. 20. The two units are permanently coupled. Pertinent information is given under item 8, Table 4.

The first a-c electric locomotive built in Japan is described under item 9, Table 4, and is shown in Fig. 21.

Fig. 22 shows a locomotive for use on the Swedish State Railways built by Nydquist and Holm. The locomotive is designed for express service and is geared for 93 mph maximum speed. Further description is given under item 10, Table 4.

Passenger Cars

Considerable interest has been evident in the intensive development work which has been in progress on the part of the car builders and two airplane companies on new conceptions of lightweight, low-center-of-gravity passenger-car trains. These trains are being designed with the goals of minimum initial cost, low operating or train expense, and reduced daily mechanical maintenance, all for the ultimate purpose of helping to eliminate the large annual deficits in passenger-train operation incurred by American railroads.

Many Experimental Train Projects. Experimental test trains of the first two designs were on the rails this year. These two were the ACF prototype "Jet Rocket" train for the Rock Island, which is a modified Talgo (11) design for service on domestic railroads, and the second is the General Motors train. Also under development by Pullman Standard Car Manufacturing Company is the "Train X" for the New York Central and the New Haven. The Budd Company has under development for the New Haven a modification of the RDC-1 (12) for high-speed multiple-unit main-line service. Budd is also building for the Pennsylvania a train of 85-ft long low-center-of-gravity cars of tubular construction, having standard platform heights at the ends for loading, but a low floor in the area between trucks.

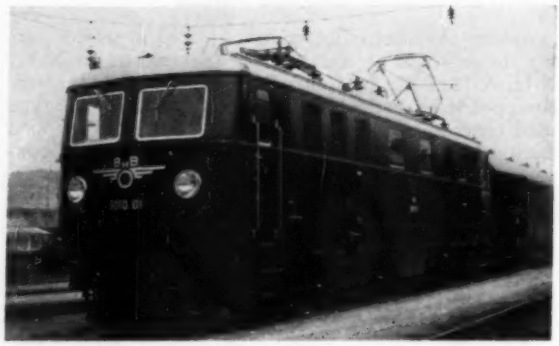

Fig. 17 5250-hp Austrian-built locomotive for passenger service in mountainous territory

ACF "Jet Rocket." Test runs of a prototype of new lightweight, low-center-of-gravity trains were made last summer with ACF Industries new American version of the Talgo design. The first production cars of this type

will be the "Jet Rocket" for the Rock Island Lines to be followed by similar trains for the New Haven. The basic features of the new Talgo design are complete reversibility and standardized design resulting in interchangeability of cars. This new design is a flexible version of the original (see Fig. 23) Talgo train. Instead of a fixed completely articulated train, separate cars, each composed of three integrally articulated units, are used in multiple. The four pairs of wheels for the three-unit car are positioned so as to support the car at all times, whether coupled or not, thus eliminating the need for individual handling of each car. Ends of the three-unit cars are equipped with quick-disconnect, tight-lock couplers for flexibility and buff-type diaphrams for passenger protection in passing between cars. Each of the individual units comprising the car is 34 ft 6½ in. long, the over-all width is 10 ft 2 in., and the floor height varies between 26 and 28 in., depending on the load conditions. A three-unit coach can seat from 84 to 96 passengers. The cars can be built of low-alloy, high-tensile steel throughout or of LAHT underframe with aluminum superstructure, or they may be stainless-steel-sheathed. The cars are designed to meet the full 800,000-lb AAR buff load. Electric heating is used, the major quantity of heat being supplied through the overhead ducts and supplemented by electric strip heaters mounted at the level of the car floor. Air conditioning is supplied by two packaged units per three-unit car. Power for heating as well as air conditioning and lighting is supplied from diesel-engine generator sets located in the head-end car.

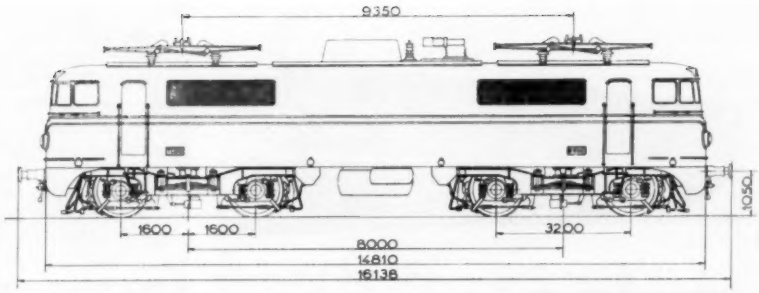

Fig. 18 Alsthom-built locomotive for operation on the Turkish State Railways

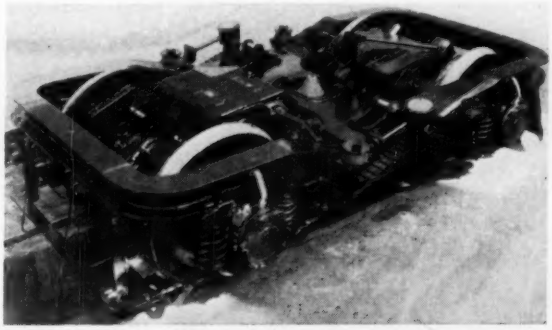

Fig. 19 Truck used on locomotive of Fig. 18, using conical rubber pivot instead of center-plate construction

Fig. 20 B-B-B-B electric locomotive built by Hitachi for Japanese National Railways

G M Demonstration Train. General Motors has built a complete train for demonstration purposes. Preliminary test runs have been made and the train was publicly exhibited in Chicago in August (13) Fig. 3. The complete consist includes one locomotive and ten cars with a total seating capacity of 400. The locomotive is 53 ft long and 13 ft 7 in. high at the cab. A two-axle power truck is used at the forward end, and a two-wheel idler axle at the rear. Propulsion power is furnished by a General Motors diesel engine which delivers 1200 hp for traction. Auxiliary power for heating, lighting, and air conditioning is furnished by two diesel engines also located in the power car. Each car is 40 ft long, nonarticulated, seats 40 passengers and weighs 30,000 lb. Two single axles are used under each car. The air-ride suspension between the axles and the car body is through two air bellows, located over each journal box. It is self-compensating for load changes and centrifugal force on curves thus insuring a level ride at all times. Shock absorbers damp lateral and vertical action, and outside rubber-cap pedestals mounted between the bellows will support the car body in event of damage to the bellows or loss of air pressure. The bodies of the cars, adapted from General Motors 40-passenger buses widened 18 in., use welded-steel underframes. Baggage will be stored under the floor and the passengers will ride at a higher level than in other lightweight trains. The center of gravity will be 45 in. above the rails. The diesel-electric locomotive is equipped with dynamic braking and only hold-

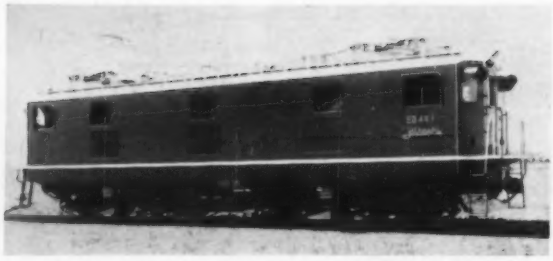

Fig. 21 The first a-c electric locomotive built in Japan for operation on 20,000 volts, 50 cps

Fig. 22 Nydquist-Holm-built locomotive designed for 93-mph top speed on Swedish State Railways

structure is almost entirely of aluminum alloy except for the low-alloy steel dome and the ends. The steel frame in the superstructure is principally in the dome section and the main end posts. The lightweight of the dome observation car is 157,965 lb, the dome coach 159,645 lb, and the diners 170,965 lb. The dome diners are a completely new design and have dining rooms on three floor levels. A reserved or private dining room offering optional seating for 10 people at one or two tables is on the lower level. The main dining room, seating 18 at circular tables for four on one side and two on the opposite side, is at the conventional floor level. The dome dining section seats 18 with a four and two-seating arrangement. The kitchens and two pantries are divided between the three levels. On the normal floor level is the kitchen, located at the opposite end of the car from the dining room, while the upper section has a small pantry served by a dumbwaiter from the main pantry which is located on the lower level.

Suburban Passenger Cars. Further expansion of suburban traffic in a number of metropolitan areas has increased interest in suburban passenger cars, particularly those with high seating capacity. The rapid growth of population and the migration to suburban areas have intensified the problems of the railroads operating commuter service. The size of present terminals imposes a limit on the number and length of trains that can be moved in and out of the stations during the morning and evening rush hours. To handle more people double-deck cars with seats on galleries, and three and two-seat arrangements on one floor level have been used. Some typical cars built in the past year are described in the following:

The Chicago and North Western obtained sixteen 85-ft double-deck air-conditioned suburban coaches for use

Fig. 23 ACF-built high-speed train of Talgo design for the Rock Island Railroad

ing brakes using a single composition shoe on each wheel are used on the cars.

While the development of lightweight trains has probably been the major topic for discussion and interest in the passenger-car field during the past year, considerable interest still exists in dome-type cars as evidenced by the number that were placed in service in the past year.

Many Dome Cars Enter Service. The Union Pacific took delivery of 59 passenger cars from ACF Industries. This group of cars included 10 dome coaches, 15 dome observation cars, and 10 dome diners. These are the first dome cars to use a structure combining aluminum and steel construction. The underframe is a low-alloy high-tensile riveted and welded assembly, while the super-

in the Chicago suburban area from the St. Louis Car Company. The cars are of the gallery type with double seats on both sides on the lower level and single seats in the upper gallery on each side of the car. The cars seat a total of 169 people, the largest capacity of any of the double-deck cars now in service. Double center-entrance doors on each side of the car are wide enough to permit simultaneous passage by three persons. Entrance steps are protected with radiant-heating panels to prevent accumulation of ice and snow.

Pullman Standard built 10 gallery-type suburban cars for the Southern Pacific's suburban service out of San Francisco. These cars are built of low-alloy, high-tensile steel, and have double center-entrance doors with three loading passages on each side of the car. The total

Fig. 24 Double-deck car of 145 passenger capacity for use in surburban service on Southern Pacific Railroad

seating capacity is 145. The lower level seats 94 people in double seats on either side of the center aisle, and the galleries seat 51 people in single seats, except for the double seats at the ends of the car. Careful study has been given to parcel storage and a novel idea was introduced in the form of a tilting rack under the double seats on the main level of the car. Extensive use is made of stainless steel in the vestibule passageways and elsewhere to insure minimum maintenance during the life of the cars. Fig. 24 illustrates the exterior of these cars.

The first of 220 new passenger cars built by Pullman Standard for the Long Island Railroad went into service in 1955. The total order includes 140 M-U cars for operation in the electrified zones, and the balance for nonelectric operation. Each car seats 120 passengers in plastic-covered seats of the three and two arrangement. The cars are of low-alloy high-tensile steel and completely air-conditioned. Fig. 25 shows the exterior of the self-propelled car.

ACF Hospital Cars. ACF Industries built for Army Transportation Corps pilot models of three new types of self-sustaining hospital cars designed for overseas service. Special axles and wheel seats permit wheel adjustments for operation on 56½, 60, 63, or 66-in-gage tracks. The three types of cars include a personnel car for the medical staff, an ambulance car with space for 30 patients, and a kitchen, diner, storage car, having a capacity of 150 persons. The unit is designed for operation at temperatures ranging from 40 to 120 F. Normally, the cars would be heated through the conventional train lines, but each car is self-sustaining with lights, water, and heat so that in an emergency they can be set off on a siding for a short layover period. The cars are equipped with both air brakes and vacuum brakes and special couplers and diaphragms permitting interchange with cars operating on several foreign broad gages.

Inspection Car for Netherlands Railroads. A novel inspection car was placed in service by the Netherlands Railroads. It is a single car powered by two 200-hp horizontal diesel engines with electric transmissions mounted under the car. Dual cabs are located in the roof, and at each end on the main level is an observation room with conference tables. Sleeping, kitchen, and toilet facilities are in the central part of the car.

Japanese Diesel Rail Car. A new type of diesel rail car was built by the Niigata Engineering Company to serve on secondary lines of the Japanese National Railways on grade sections. Two 160-hp underfloor engines drive one axle of each truck through hydromechanical transmission. The balancing speed when loaded to full capacity (134 persons) on 1.5 per cent grade is 47 mph, and on 2.5 per cent grade 25 mph. The motorman's cab is at one end. Usually two cars are operated in multiple. The lightweight of the car is 73,600 lb and its over-all height is 11 ft 6 in. Fig. 26 shows this car.

Fig. 25 Exterior of one of 220 new passenger cars for the Long Island Railroad

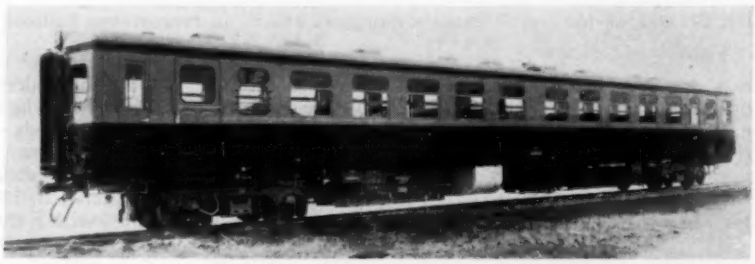

Fig. 26 Japanese-built diesel-hydraulic car designed for operation on secondary line

Fig. 27 Articulated diesel-hydraulic rail car built by Drewry Car Company for New Zealand

Rail Cars for New Zealand. In New Zealand the Drewry Car Company built 35 articulated diesel-mechanical rail cars for the New Zealand Government Railways, Fig. 27. There are three four-wheel trucks. The two axles at each end of the car are driven, while the center axles are idle. Two 210-hp, 1550-rpm engines are used. The car seats 88 passengers and has a top speed of 60 mph.

Suburban Cars for Turkish Railways. Partial delivery of an order of eighteen 3-car suburban units for the Turkish State Railways was reported by Alsthom, Fig. 28. The

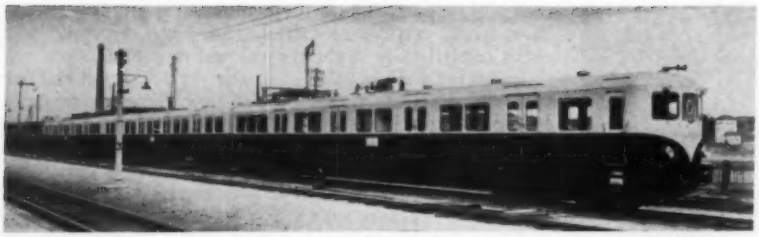

Fig. 28 Three-car suburban unit built for operation on Turkish State Railways

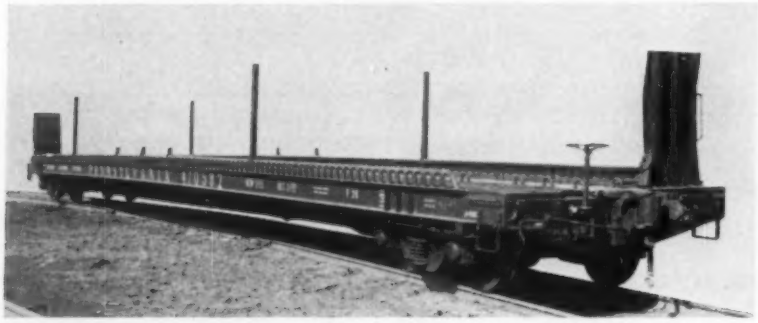

Fig. 29 One of 400 cars designed to transport trailers on Pennsylvania Railroad

cars are propelled by series commutator-type motors operating from 25,000-volt 50-cps line. The three-car unit consists of two motored cars with a trailer between them. Only the two end trucks of the three-car unit are motored. The truck design is similar to that used in the Alsthom locomotives covered earlier in this report, Fig. 19.

Freight-Car Developments

Developments in the freight-car field during the past year bring to the forefront the continued emphasis being given special-purpose cars; i.e., cars designed to handle a specific commodity, especially with a reduction in the labor of loading and unloading and the expectation of added protection against loading damage. Next is the continued development work that is going into improving components. Major efforts in component development work have been directed toward improvements in brakes and bearings and the continued expansion of mechanical refrigeration.

Expansion in "Piggyback" Service. During the past year rail-trailer or "piggyback" service has expanded greatly. In many instances existing flatcars have been converted for use in this service but two new types of cars have been built which are most interesting.

The Bethlehem Steel Company delivered to the Pennsylvania Railroad (and the Pennsylvania built a like number in its Altoona Shops) 200 specially designed flatcars for handling two highway trailers per car for the Pennsylvania "Truc-Train" service. While the cars are primarily intended for handling highway trailers, they also meet AAR loading requirements and are readily adaptable for general service. End loading of trailers is provided and the common arrangement of drop and runways between car, side guard rails, and hold-down chains are used. Fig. 29 illustrates the car. The length over end sills is 75 ft. The width over side sills is 9 ft 6 in. The lightweight of the car is 79,000 lb, giving a load limit of 130,000 lb. Center and side sills, as well as other main parts of the structure subject to high stresses, are of low-alloy, high-tensile steel, the balance of the car being of open-hearth steel.

An experimental flatcar of new design for "piggy-back" service, evolved from a French development, is being offered by Piggy-Back, Inc. The first of these cars was demonstrated and tested by the New Haven. It is a lightweight, low-cost, 75-ft car, consisting essentially of a center sill without floor or side sills. The center sill forms a rail to support and guide two-wheel dolly assemblies mounted on the trailer axle. These dolly wheels, rather than the tires, support the trailer and permit rapid guided backing of the trailer into place using a special tractor also guided by the center-sill rails. Once the trailer is positioned, tie-down clamps, a part of the underframe and operated from the ground, securely lock the trailer in position on the flatcar in a matter of seconds. Shock-absorbing devices incorporated with the tie-down mechanism cushion the trailer against longitudinal shock. Because the trailer wheels straddle the center sills, 12-ft 6-in-high highway trailers may be handled within the limits of Eastern railroad clearances. Fig. 30 illustrates this car.

German Version of Rail-Trailer Car. The German railroads are experimenting with a new type of car, actually a variation of rail-trailer service, which is designed for door-to-door delivery of freight. The car can travel on rails as a normal freight car or become a road trailer that can be hauled by a truck. It is equipped with four standard flanged wheels, buffers, couplings, and braking system. Stowed beneath the underframes are four rubber-tired road wheels. When the car reaches the railhead nearest to its destination, the road wheels are fixed to the hubs of the flanged wheels, a towing bar is attached, and one pair of wheels is released from its fixed position so that it can swing to left or right and negotiate corners. The car is then coupled up to a truck or tractor and towed to its destination. The car measures 28.7 ft long, is 8.26 ft wide, and has a tare weight of 7.36 tons.

ACF Container Car. A new concept in the transportation and handling of bulk commodities was introduced by Shippers Car Line in the ACF container car. Twenty-eight separate aluminum bulk containers, each with a capacity of 74 cu ft and 3615 lb net, are locked with side and overhead bars to a special 54-ft flatcar weighing 67,700 lb including containers, for transit. Each container may be filled on or off the car through a top opening and may be emptied by tilting to an angle of 45 deg so the contents pour out through a discharge door at the bottom of one face of the container. One man with a fork-lift truck can unload the car within an hour.

Adaptability to mixed shipments and trucking of containers from a railroad siding to a consignee are special features of the design. Fig. 31 shows the car with containers in place.

Car to Handle Coiled-Steel Shipments. New methods of handling coil steel in open-top flatcars and protection of this coil steel against weather and damage en route were developed and introduced by several railroads during the past year. Basically, this system utilizes standard gondola cars with guideable skids resting on the floor of the car and having their ends cushioned against impacts by means of springs or rubber shock absorbers interposed between the skids and the car body. The foils are placed on the skids between two cross beams and then covered with a tarpaulin or a removable quonset-type hatch. The entire design is developed to enable a single crane operator to unload or load the car. Fig. 32 shows the Pennsylvania Railroad version of this car.

Special Cars for Wallboard. Special flatcars designed for shipment of gypsum sheet-rock board and other wallboard were first tried out on the Illinois Central in 1947, using old pulpwood cars. Their use has been extended to a number of roads and, while still similar to a pulp-wood car with a level floor, improvements have been made and end lockers are now used on these cars for the stowing of "Perf-A-Tape" thus making a complete shipment.

Refrigerated Cars. Interest in mechanically refrigerated cars, particularly for the handling of frozen-food products at 0 F, or less, continues. The Northern Pacific obtained 50 mechanically refrigerated cars built by the Pacific Car & Foundry Company utilizing Frigidaire refrigeration equipment. Blower fans draw air from the floor and circulate it through flues in the ceiling and down side-wall ducts. It then returns under the floor racks. There are two complete refrigeration systems controlled by a single thermostat with a range of 10 to 70 F. Each has a 5-hp condenser unit and evaporator with heater units, designed to give either heat or refrigeration as required.

General Motors built an experimental mechanically refrigerated car incorporating a number of new ideas. The car has been tested in service by the Fruit Growers Express Company. The most important innovations are a cushion underframe and a new system of cold-wall refrigeration. The underframe is one unit and the body which is completely self-supporting and independent of the underframe, is a separare box resting on the underframe and supported by four pads, one at the outer end of each bolster. A Type F coupler in combination with a long-travel draft gear is used in the underframe. A long lug forming a reinfcrcement of the car body under the doorway on each side of the car projects downward into a pocket in the underframe. Imposed between each end of the body lug and the underframe pocket are rubber-mat cushioning devices. Fig. 33 shows the prototype of the production model of the G-M refrigeration car.

Fig. 30 Car capable of handling two trailers of 12-ft 6-in. height within the limits of Eastern railroad clearances

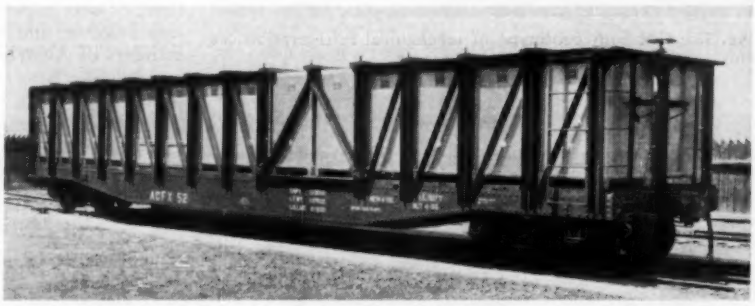

Fig. 31 ACF-built car equipped with aluminum bulk shipping containers

Fig. 32 Car designed for use in handling coiled steel strip

Mobile Gas-Turbine Power Plants. Mobile gas-turbine power plants for use in emergencies have been built for the U. S. Army and the U. S. Navy Bureau of Yards and Docks. The Army power plant, built by Westinghouse, is a 5000-kw unit arranged in two 54-ft railway cars, one

Fig. 33 GM-built prototype of mechanical refrigeration car employing cold-wall principle

tures of the AB brake which were so effective in train handling and adding several new features and functions. The new valve and dirt collector are interchangeable with the old valve but offer a number of improvements in design and operation. Features of design, such as the use of diaphragm pistons instead of pistons with rings, were developed to minimize maintenance and lengthen the intervals between cleaning. Operation is improved by means of better valve sensitivity, making application and release more positive. Brake release is accelerated to control shock so that release can be accomplished at low train speeds without damage.

Acknowledgments

The Committee on Survey acknowledges with deep appreciation the assistance in procuring material for the report given by the *Railway Age*, *Railway Locomotives & Cars*, *Modern Railroads*, *The Railway Gazette*, *Diesel Railway Traction*, and by the railroads, locomotive, and car builders of Austria, Belgium, Canada, England, France, Germany, Holland, Japan, New Zealand, Scotland, Sweden, Switzerland, and the United States.

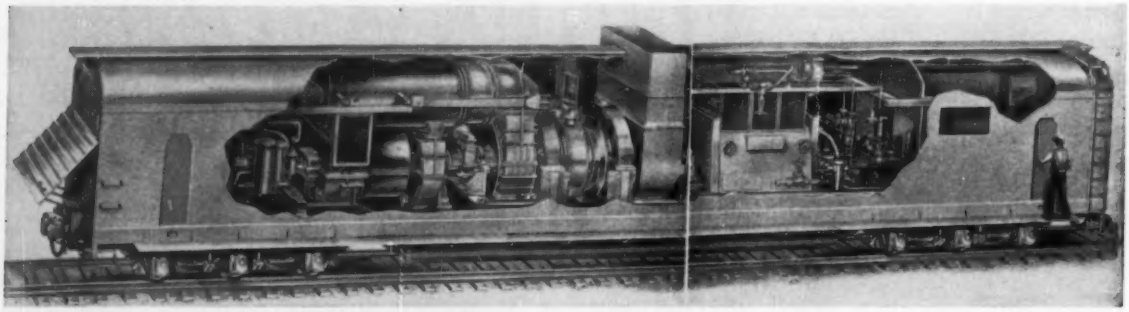

Fig. 34 Mobile gas-turbine power-plant car of the type being built for the United States Navy for use during emergencies

carrying the turbines and generator and the other the switchgear, auxiliary equipment, and main transformer. Upon arrival at the site, the power plant can be put in operation in a matter of hours. The 5500-kw Navy unit, built by Clark Bros. Co., is similar except it does not have a transformer installed. This permits it to be complete in one car. The general arrangement is shown in Fig. 34. Auxiliaries are connected to an auxiliary engine-driven generator.

Bearing Lubrication and Brake Equipment

No discussion or treatise on railroad equipment is complete without some mention of the ever-important problem of journal bearings, and their lubrication and maintenance. Roller bearings have been used in some freight cars for many years and each year the number of roller-bearing-equipped freight cars is enlarged. Intensive study and experimental work on solid bearings, their lubrication, and their associated parts in the journal box are being continued. Better contour and fix between the bearing and the journal, along with new devices or means of supplying the journal with oil, give every indication of securing vastly improved service from solid bearings.

The Westinghouse Air Brake Company has developed its "AC" freight-brake equipment utilizing all the fea-

Bibliography

1 "The Development of 50-Cycle, Single-Phase Locomotive in the Near Future," by Fernand Nouvion, Document No. 16; and "Rectifier Locomotives and Motor Coaches," by M. Marcel Tessier, Document No. 14; delivered at the Convention on Electric Traction by Single-Phase Current at Industrial Frequency (Lille, May, 1955).

2 "Progress in Railway Mechanical Engineering," MECHANICAL ENGINEERING, vol. 75, April, 1953, p. 299.

3 "Progress in Railway Mechanical Engineering," MECHANICAL ENGINEERING, vol. 77, April, 1955, p. 316.

4 "Progress in Railway Mechanical Engineering," MECHANICAL ENGINEERING, vol. 77, April, 1955, p. 317.

5 *Railway Age*, vol. 139, July 18, 1955, p. 26.

6 *Railway Locomotives & Cars*, vol. 5, May, 1955, p. 10.

7 Bituminous Coal Research, vol. 15, May-June, 1955, p. 9.

8 *Modern Railroads*, vol. 10, September, 1955, p. 103.

9 "Progress in Railway Mechanical Engineering," MECHANICAL ENGINEERING, vol. 75, April, 1953, p. 294.

10 "Rectifier Locomotives for the N.Y., N.H. & H. R.R.," by F. D. Gowans, AIEE Paper No. 55-206.

11 See "Progress in Railway Mechanical Engineering 1948–1949," MECHANICAL ENGINEERING, vol. 72, April, 1950.

12 See "Progress in Railway Mechanical Engineering 1948–1949," MECHANICAL ENGINEERING, vol. 72, April, 1950.

13 *Railway Age*, vol. 139, September 5, 1955, p. 38.

Science Changes the Scientist Too!

By Gilbert E. Doan

Manager of Metallurgical Research, Koppers Company, Inc., Pittsburgh, Pa.; Head of Department of Metallurgical Engineering at Lehigh University, 1939–1952

In escaping from the trend toward materialism, the author suggests that the engineering student must learn at college that science is based on faith as are also both religion and democracy; that faith beyond intellectual comprehension is necessary if he is to see life steadily and to see it whole; that with this faith he will not feel the need to escape into a world where only measurable quantities are real, where only material values are satisfying, and where all emotion is suspect. He will welcome life and human personality as they are. Each college must find the best way to point out these truths.

We've always thought that scientific training, and in particular engineering education, developed in a young man the best possible traits and characters: careful observation of facts instead of the hazy impressions of childhood, accurate measurements instead of the slipshod guesses of his youth, and rigid logic as taught by the laws of science, where careless thinking had prevailed in adolescence. This is a disciplining of the mind that makes a young man trustworthy, frees him from superstition, and develops the habit of quantitative thinking. These are immense gains for a young man about to face the world.

Engineering is a constructive profession in which man's needs are served in a man's way by building bridges, factories, houses, automobiles, railroads, and electric systems, raising better crops through tractors and chemical fertilizers, manufacturing plastics and metals, airplanes and atomic plants. This is man's work in the best tradition!

Finally, in this pursuit of science the young man is pursuing truth. "Ye shall know the truth and the truth shall make you free." Great spirits such as Newton and Einstein, Franklin, and Maxwell, Planck, Millikan, Hoover, and the Comptons have led the way.

Why then, you say, if the study of science is so good in all of its influences and promises, have the engineering colleges voluntarily taken as much as 20 per cent of a college engineering curriculum away from the study of science and devoted it to the humanities? Is the study of science alone inadequate to the full development of the all-round man? Or (perish the thought!) may the study of science also have strongly *undesirable* effects on the growth of an individual scientist?

Observe, please, that it is the engineers themselves who have relinquished this 20 per cent of a boy's four years at college, men who themselves have studied and practiced and taught engineering who advocated this attention to the nonscientific studies, acting through the American Society for Engineering Education, back in 1945. It is our purpose here to see what are the adverse effects of science on its students and to note whether the 20 per cent of correctives are effective.

For, note that it was not only in the niceties of the young man's life, the refinements, the finishing touches that engineering education needed this corrective. In its earlier intensity it had produced warped, wooden, stunted human beings, "slide-rule engineers," except where men overcame the malnutrition of its monotonous diet.

The Retreat Into Materialism

All progress in science has been made by rigidly excluding from each experiment all except the physical facts. There is no place in chemistry or physics or electrical engineering for emotion. All emotion must be rigidly excluded or you will miss the scientific point. The student comes to see emotion and impulse as something destructive–the cause of error in science. He gradually becomes emotionally inhibited—he becomes a timid and submissive person.

Likewise, the realm of the spirit, and all questions of taste and quality, must be excluded from scientific discipline. "Only that which can be measured is real," Count Rumford is reported as saying. The obvious step is to simplify all of life and bring it within the scientific laws he is learning by sharply excluding all such nonmeasurable factors. This habit leads, in his nonprofessional activities, to an escape from reality into a false security called "materialism." The result is a timid, spiritless person. This stunted person comes to inhabit a rigid mechanical world where his imagination dies and his creative ability languishes unborn.

The third and most serious change that the study of science produces in the student is the destruction of his faith. As understood by the student, science is built on *proof*. Therefore all faith is a delusion, a superstition.

But democracy's deepest convictions—justice, truth, mercy, the dignity of the individual—all rest on faith, that is, on beliefs which cannot be proved either by logic or by experiment. And actually science too is built on faith, surprising though that sounds.[1] Vannevar Bush, former vice-president of the Massachusetts Institute of Technology and head of the nation's scientific effort in World War II, points out that this destruction of a young scientist's faith is a common occurrence. He says:[2] "To those young scientists who derive their motivation from their religion we do not need, as scientists, to speak. To those who have lost this anchor, *sometimes through the very intensity of their devotion to science*, we offer a (substitute) motivation that is

[1] "The New Position of Science," By G. E. Doan, MECHANICAL ENGINEERING, vol. 77, January, 1955, pp. 28–29.

[2] "For Men to Know," *Atlantic Monthly*, August, 1955.

worthy of their best efforts" (emphasis supplied). The loss of faith which Dr. Bush points out is another of the highly undesirable results of a scientific education as it is today, undermining as it does a man's whole personality. Thus science, as it is taught, has brought discredit on the deepest convictions of our western faith because these convictions are not subject to proof. Loss of faith and distrust of emotions are an exceedingly bad combination for a young man about to face the world.

Of course a student's previous home, church, and community life may be so sound and strong that he survives these destructive influences at college. But college life is a cloistered life for four of the young man's most impressionable years, and scientific indoctrination is highly effective. Dr. Bush knows this indoctrination well. He says, speaking again of the young scientist's motivation: "What do we say to the young man who is immersed in science with his whole life wrapped up in it? The new things he must master, if he will advance with his fellows beyond superficiality to creative activity in a specialized field, are so numerous and difficult that he has little time to spend on philosophical thinking of the past. He is prone to acquire his philosophical orientation accidentally or casually from his science teachers, and in doing so he may be misled. For I fear that some of the things that are told him in this respect by scientists are *erroneous, logically unsound;* yet they are likely to be accepted by him *just because they appear in scientific dress*" (emphasis supplied). Thus timidity and cynicism, wrapped up in confusion, come to thousands of science and engineering students every year as a result of the scientific brainwashing of an engineering education. Science changes the physical world we live in but it also changes the scientist. It destroys his faith, his courage, and many of his finer perceptions. *And this destruction is unnecessary.* It arises from a false estimate of the validity of scientific truth.

The Corrective 20 Per Cent

It seems clear that the task set for the 20 per cent of humanities in an engineering curriculum is a very definite task. Primarily it must restore faith to its central position in a man's life, not only for the sake of science and for the preservation of democracy and religion, but principally for his own growth *as a man.* Also, it must teach full acceptance of human personality, including the driving force of the emotions. These, I submit, are the primary demands.

President Eisenhower, when told recently about the shortage of engineers in the United States as compared with Russia, remarked: "How I wish that someone could tell me what kind of a program would produce just one reliable moral philosopher." He would take his chances, he said, on America's being able to produce the scientists and the engineers needed; but how he would like to find the formula for the production of someone who would be able to tell him what was the right thing to do. This is the need of our times—strong and sound men, *as men,* and this is the task set for the 20 per cent of the engineer's curriculum.

As long as we believed that science was revealing ultimate truth we followed it without hesitation. The price paid yearly in thousands of human sacrifices to the disciplines of science did not seem too high. Our trust that "Ye shall know the truth and the truth shall make you free," led us on. But now that we realize that the "truths" of science constantly change, that they are severely limited at all times, that science too is based on faith,[1] we no longer can neglect the warping effect of its disciplines on a man's growth *as a man.* The individual man is still our central value[1] in the West. The growth and maturing of the son as a person is far more dearly prized by the parents than his acquisition of a narrow set of skills. His advancement to a responsible position later in life also depends on this growth and maturity, *far more than it does on engineering skill,* ironic though that may seem to an engineering student. It is now clear what the 20 per cent ought to accomplish, namely, the return of faith to its central position in a man's life and with it encouragement to him to face up to the complexity of life as it really is, including its emotional drives, and not to retreat from actual life into materialism.

Somehow every science teacher must make the simple admission to his students that there are no *basic* truths in science; that Newton's laws, useful as they still are, ceased to be a true expression of reality with the proof of relativity; that the conservation of energy and the constancy of mass went out with the advent of nuclear physics; *that there are no more basic truths than these in science;* and that these latest truths too will some day be abandoned. Such an admission of fact by the science teacher will free the science student from a dangerous delusion, and from inner conflict with the really basic teaching of his church and his home. This is the area of false teaching to which Dr. Bush refers as "erroneous, logically unsound."

This admission by the science teachers is the missing element in engineering education which has, until now, rendered sterile the twenty per cent of humanities in the engineers' curriculum, even where they have been properly chosen. The science teacher's representation that scientific laws are matters of *fact* while the humanities are matters of *opinion* only, has killed the student's interest outside of the field of science. Instead of broadening his sympathies and freeing his mind, science has enslaved his mind to a rigid system of temporary beliefs, the current dogmas of science. This has been done unwittingly, and unintentionally, by the teachers of science in their zeal. All that is needed is a statement of the truth from the science teachers about the fiduciary nature of scientific theory, as well as its excellences and values. The *truth is sufficient to correct the situation.* With this full presentation of the facts by science teachers the 20 per cent of humanities will *for the first time* have a chance to become effective with engineering students.

The student must be made to realize that though scientific knowledge is useful, the scientist's belief that he will some day discover unchanging truth is an act of pure faith. Thus scientists themselves still live by faith, because of the limitations of the human mind in framing scientific laws, even the mind of a Newton and an Einstein. Man becomes whole by *worship* of the Supreme Intelligence, not by pretending he himself is supremely intelligent, or is becoming so through science.

Will the engineering and science colleges recognize these needs? I can only say that a group of men with the vision and integrity shown by the engineers in ceding one fifth of a student's studies to nonengineering courses will not rest until the student gets the truth.

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[1] "The Dignity of Man," by Russell Davenport, *Harpers,* 1955.

Difluorodichloromethane

As a Boundary Lubricant for Steel and Other Metals

By S. F. Murray, R. L. Johnson, and M. A. Swikert

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IT HAS been suggested[1] that fluorine and chlorine substituted methane and ethane derivatives be considered as possible high-temperature lubricants. Gases with two or more chlorine atoms in the molecule were found to lubricate SAE 1020 steel under the conditions of the experiments. Difluorodichloromethane was one of the effective gaseous lubricants for steel. Because it is thermally stable in the presence of steel wool at temperatures[2] above 800 F difluorodichloromethane merits particular consideration as a possible high-temperature lubricant.

The mechanism of lubrication for these halogenated gases includes chemical reaction with the mating metals to form a solid surface film such as iron chloride in the case of steel. The occurrence of chemical reactions as part of the lubricating process suggests that the metals used for the sliding surfaces might be extremely important in lubrication with these gases.

This paper describes experiments to determine the ability of difluorodichloromethane to lubricate various metals of interest for bearing surfaces in turbine engines. The investigation was carried out at the NACA Lewis laboratory. A kinetic-friction apparatus having a hemispherical specimen sliding on a rotating disk was operated in an atmosphere of difluorodichloromethane. The study of various materials included combinations of steel types and hardnesses and possible cage materials on hardened steel. After a brief run-in period at low speeds and light loads, friction force was measured at a sliding velocity of 120 fpm and with a load of 1200 grams (initial Hertz surface stress 158,000 psi). The data reported were obtained at room temperature.

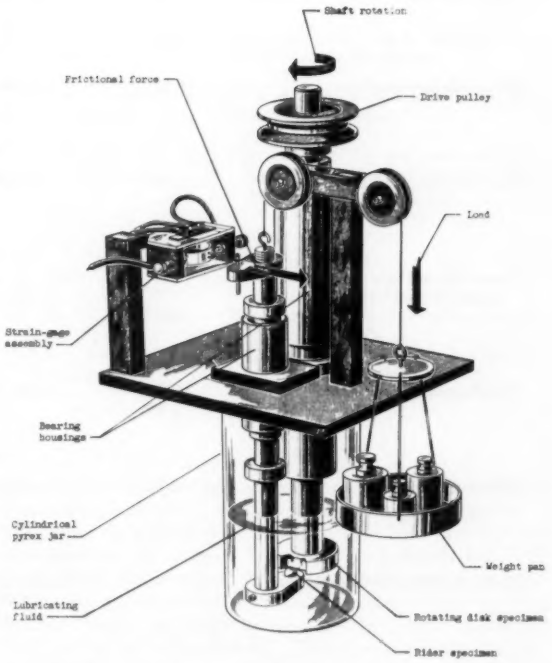


Fig. 1 Schematic diagram of friction apparatus for studying boundary lubrication by gases. Pyrex jar shown was used for liquid lubricants; for gaseous lubricants, jar was replaced with an Inconel pot.

Apparatus and Procedure

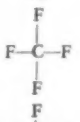
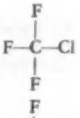
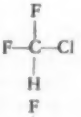
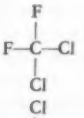
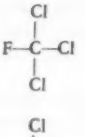
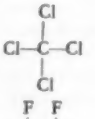
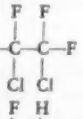
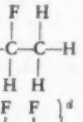
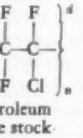
The apparatus used for most of the experiments is shown schematically in Fig. 1. The basic elements are a rotating-disk specimen ($2^1/_2$ in. diam) and a hemisphere-tip rider specimen (tip radius, $^3/_{16}$ in.). The material combinations are specifically described as the data are presented. During a run, the stationary rider slides in a continuous circumferential path on the flat surface of the rotating-disk specimen. The disk is rotated through a belt system by an electric motor coupled to a variable-speed power-transmission unit. For the gaseous lubricants, a 2-liter Inconel pot, with several strip heaters mounted on the outside wall and a concentric set of ring heaters underneath, was used in place of the pyrex jar shown in Fig. 1. Loading was applied to the rider specimen by the use of dead weights acting through the pulley system. The loads used in this investigation were between 200 and 1200 grams (initial Hertz surface stresses, 87,000 to 158,000 psi). Friction force between the specimens was measured by means of four strain gages mounted on a copper-beryllium dynamometer ring; the strain-gage readings were registered on an indicating-type calibrated potentiometer. Repetitive tests indi-

[1] "Boundary Lubrication of Steel With Fluorine and Chlorine Substituted Methane and Ethane Gases," by S. F. Murray, R. L. Johnson, and M. A. Swikert, NACA TN 3402, February, 1955.

[2] "The Stability and Corrosive Properties of Dichlorodifluoromethane 'Freon'—'F-12,'" by R. M. Buffington and H. M. Fellows, Technical Paper No. 5, Kinetic Chemicals, Inc., Wilmington, Del., May 20, 1931.

Contributed by the Research Committee on Lubrication under the auspices of the Lubrication Activity of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS, and presented at the Second Annual ASME-ASLE Lubrication Conference, Indianapolis, Ind., October 10–12, 1955. Condensed from ASME Paper No. 55—LUB-2.

Table 1 Experimental Lubricants[1]

Lubricant	Specific gravity of gas (air = 1)	Boiling point, deg F	Structure
Air	....	....	....
Argon	1.38	−301[a]	A
Tetrafluoromethane	3.04	−198.4[b]	
Trifluorochloromethane	3.60	−114.7[b]	
Difluorochloromethane	2.98	−41.44[b]	
Difluorodichloromethane	4.17	−21.64[b]	
Fluorotrichloromethane	4.74	+74.78[b]	
Tetrachloromethane (carbon tetrachloride)	5.31 (gas)	+170[a]	
Tetrafluorodichloroethane	6.0 5.90[a]	+38.39[b]	
Difluoroethane	2.28	−12.5[a]	
Trifluorochloroethylene polymer	....	Viscosity,[c] 4.13 cs at 100 F	
Grade 1010 turbine oil	....	Viscosity,[c] 9.95 cs at 100 F	Petroleum base stock

[a] "Handbook of Chemistry and Physics," edited by C. D. Hodgman, Chemical Rubber Pub. Co., 35th edition, 1953–1954.
[b] "'Freon' Compounds—for Use as Refrigerants, Propellants and Other Applications" (anonymous), Kinetic Technical Bulletin B-2, Kinetic Chem., Inc., Wilmington, Del., c. 1950.
[c] Measured data.
[d] Chain endings probably derived from solvent; rigorously fluorinated.

The experimental compounds used previously[1] and in the present tests and some of their properties are listed in Table 1. The gases were commercial-grade materials having purities higher than 97 per cent. The impurities were primarily noncondensible gases, with less than 0.0025 per cent water. In the experiments, gas was piped from the cylinder to the experimental apparatus through Tygon tubing and a stainless-steel elbow tube that extended from the top almost to the bottom of the Inconel pot. Gas flow was measured by means of a calibrated flowmeter. The rate of flow was 4 liters per min. An analysis of the atmosphere in the pot in runs using difluorodichloromethane and tetrafluorodichloroethane showed that the oxygen content was less than 0.5 per cent after 5 min. at this flow rate (equivalent to changing the atmosphere of the pot 10 times). Since this flow rate was maintained at all times during the test runs, contamination from the air was assumed to be negligible.

An unused set of specimens was used for each test. Gas flow was started 5 min before the test in order to displace the air. A standard run-in procedure followed purging of the container. The following run-in procedure was used: At a constant speed of 55 fpm, the specimens were run with the following arbitrary loads and time periods: 200, 400, and 600 grams for 1 min each, and 1200 grams for 2 min. The same run-in procedure was used for all combinations of various materials. A friction run comprised 60 min of continuous operation; readings were taken at random time intervals unless some change in conditions occurred. Runs were made at a sliding velocity of 120 fpm with a load of 1200 grams (initial Hertz surface stress, 158,000 psi).

cated that friction coefficient values were generally reproducible to within ±0.02.

The method of finishing specimens included rotation in a drill press while the surface was rubbed with successively finer grades of abrasive cloth. Grade 1/2 polishing cloth followed by a brief rubbing with crocus cloth produced the final finish of the disk specimens. This procedure left uniform circumferential finishing marks on the disk; surface roughness, as measured with a profilometer, was approximately 15 to 17 microinches rms. The rider specimens were polished with grade 3/0 emery paper.

Friction measurements are presented as values of coefficient of friction f, the ratio of friction force to load. As bases for evaluating lubricating effectiveness, the following observations were considered most important:

1 Value of coefficient of friction.

2 Behavior of the specimen during the test. Instability of friction force and audible chatter of the specimens indicated ineffective lubrication.

3 Condition of the surfaces after the test:

(*a*) No evidence of surface failure; effective boundary lubrication.

Table 2 Summary of Results for Various Gases With SAE 1020 Steel Specimens;[1] Based on Friction, Wear, and Surface Damage

Number	Lubricant	Relative lubricating effectiveness	Representative coefficient of friction[a] (speed, 120 fpm; load, 1200 g)	Representative condition of surfaces	Remarks on lubrication
1	Air	Poor	0.58–0.64	Mass failure	Mass failure during run-in at all loads and speeds
2	Argon	Poor	0.53–0.65	Mass failure	Similar to air
3	Tetrafluoromethane	Poor	0.57–0.67	Mass failure	Similar to air
4	Trifluorochloromethane	Poor to fair	0.4–0.6	Incipient to mass failure	Some beneficial effect on wear and surface condition
5	Difluorochloromethane	Poor to fair	0.4–0.6	Incipient to mass failure	Some beneficial effect on wear and surface condition
6	Difluorodichloromethane	Good	0.13–0.17 0.32 at 480 F	Effective boundary lubricant	Friction higher at high temperature, no change in wear or surface damage
7	Fluorotrichloromethane	Good	0.22 at 100 F	Effective boundary lubricant	Friction higher than 6, similar to 6 in wear and surface damage
8	Carbon tetrachloride (liquid)	Good	0.23–0.4	Effective boundary lubricant	Friction high, wear and surface appearance similar to 6
9	Carbon tetrachloride (gas)	Good	0.1 at 200 F	Effective boundary lubricant	Friction lower for gas than for liquid state. Wear and surface appearance similar to 6
10	Tetrafluorodichloroethane	Good	0.15	Effective boundary lubricant	Similar to 6
11	Difluoroethane	Poor	0.54–0.64	Mass failure	Similar to air
12	Trifluorochloroethylene polymer	Good	0.12	Effective boundary lubricant	Wear-scar diameter slightly less than 6
13	Grade 1010 turbine oil	Excellent	0.11	Effective boundary lubricant	Wear-scar diameter smaller than for any other lubricant tested

[a] At room temperature unless stated otherwise.

(*b*) Evidence of some surface welding; incipient failure.

(*c*) Evidence of extensive welding and metal transfer; mass failure.

(*d*) Diameter of wear scar.

The data presented are for runs that are representative of the results obtained in 2 to 12 runs on each variable.

Experimental Results

Various Lubricants. The results of previous experiments[1] are vital to this paper and are therefore summarized in Table 2; the various gases are described in Table 1. It was apparent that compounds containing fluorine and two or more chlorine atoms per molecule functioned as boundary lubricants to reduce friction and to prevent surface welding and metal transfer. Difluorodichloromethane, tetrafluorodichloroethane, and other gases lubricated almost as well as conventional liquid lubricants. Difluorodichloromethane lubricated mild steel well enough at 480 F to prevent excessive wear, surface failure, and metal transfer.

Various Metals. The results of experiments with various material combinations are presented in summary form in Table 3. All these data were obtained using difluorodichloromethane as the lubricant.

Steel. The previously discussed runs were all made using both rider and disk specimens of SAE 1020 steel. The performance of that combination compared with other steels (Table 3) shows considerable difference. Effective lubrication was also obtained with a hard rider specimen (SAE 1095, Rockwell C-60) sliding against a hard steel disk (tool steel, Rockwell C-62). Neither the combination of a hard rider on an unhardened disk (SAE 1020, Rockwell A-50) or an unhardened rider on a hard disk were as well lubricated as when the mating surfaces were approximately of the same hardness (either hard or unhardened). The combination of a 347 stainless-steel rider on a disk of the same material was not lubricated by difluorodichloromethane.

Silver. Silver is one of the favored metals for use in many bearing applications. When both specimens were made of solid electrolytic silver, lubrication by the gas was not effective and extremely high friction was obtained. The combination of a solid-silver rider on a tool-steel disk gave lower friction but lubrication was inadequate. The friction coefficient was approximately twice that normally obtained with good lubrication by the gas. The silver-rider specimen experienced heavy wear. A bronze-rider specimen having a 0.005-in-thick plating of silver and with a flash overplate of lead was run against a tool-steel disk. Lubrication was no more effective than in the case of the solid-silver rider. The plating was quickly worn away and the underlying bronze was not lubricated effectively.

Copper. Electrolytic copper was used as the rider specimen and run against an SAE 1020 steel disk. The difluorodichloromethane was a poor lubricant for that combination. The copper wore badly and there was considerable metal transfer to the disk. A beryllium-

Table 3 Summary of Results for Various Metals Lubricated With Difluorodichloromethane; Based on Friction, Wear and Surface Damage

(Speed, 120 fpm; load, 1200 grams)

Rider specimen material	Disk specimen material	Relative lubricating effectiveness	Representative coefficient of friction	Representative condition of surfaces (as compared to running in air)
Mild steel (Rockwell A-50)	Mild steel (Rockwell A-50)	Good	0.13 to 0.17	Wear and surface damage similar to results with liquid lubricants
High-carbon steel (Rockwell C-60)	Mild steel (Rockwell A-50)	Poor to fair	0.40 to 0.60	Some beneficial effect on wear and surface damage
Mild steel (Rockwell A-50)	Tool steel (Rockwell C-62)	Poor	0.70	Heavy wear of rider specimen
High-carbon steel (Rockwell C-60)	Tool steel (Rockwell C-62)	Good	0.14 to 0.18	Wear and surface damage similar to results with liquid lubricants
347 Stainless steel (Rockwell A-51)	347 Stainless steel (Rockwell A-51)	Poor	1.00 to 1.10	Severe surface damage and welding
Electrolytic silver (Rockwell A-38)	Electrolytic silver (Rockwell A-38)	Poor	1.20	Heavy wear and surface damage
Electrolytic silver (Rockwell A-38)	Tool steel (Rockwell C-62)	Poor to fair	0.33	Heavy wear of silver
Electroplated lead flash over silver on bronze	Tool steel (Rockwell C-62)	Poor to fair	0.33 to 0.42	Plating quickly worn away; fairly heavy wear of bronze
Pure copper (Rockwell A-41)	Mild steel (Rockwell A-50)	Poor	0.50 to 0.70	Heavy wear of copper, considerable metal transfer to disk
Beryllium copper (Rockwell C-36)	Tool steel (Rockwell C-62)	Good	0.20	Effectively lubricated
Modified H-Monel (Rockwell A-63)	Tool steel (Rockwell C-62)	Good	0.17	Effectively lubricated
Cast Inconel (Rockwell A-50)	Tool steel (Rockwell C-62)	Poor to fair	0.35 to 0.40	Some beneficial effect on wear and surface damage

copper alloy was run against tool steel and lubrication by the gas was effective. The friction coefficient was 0.2 and wear of the rider was slight.

Nickel Alloys. A modified H-Monel rider specimen sliding against tool steel was effectively lubricated by difluorodichloromethane. The friction coefficient (0.17) was lower than that obtained with beryllium copper (0.20) and was in the same range as the effective steel combinations (0.13 to 0.18). Cast Inconel sliding on tool steel was not a satisfactory combination for lubrication by the gas. The gas did, however, have some beneficial effect on wear and surface damage.

Discussion of Results

Chemical tests showed qualitatively that a chloride film had been formed with difluorodichloromethane lubricating steel.[1] Lubrication by these gases is believed dependent on chemical reaction to form surface films. Therefore it should be expected that, for a given gas, lubrication effectiveness would vary with different metal combinations. The data given in Table 3 substantiate this expectation. Modified H-Monel sliding against hardened tool steel was one of the more satisfactory combinations that included nonferritic materials.

An important effect of hardness with steel combinations was noted. It is apparent that the best results using steel surfaces were obtained when both specimens were of nearly the same hardness. It appears questionable (e.g., silver on silver) that this effect can be extended to combinations of other materials.

Austenitic stainless steels such as the 347 material used in data reported herein are considered very poor materials for sliding surfaces.[3] Difluorodichloromethane did not lubricate stainless steel although the specimens were of similar hardness. The result emphasizes the important fact that similar hardness by itself is not an adequate criterion for selecting materials but that they should be capable of forming surface films by chemical reaction. Cast Inconel is also resistant to chemical attack but when run against a tool steel (which was more capable of forming a reaction film) the gaseous lubricant did have some beneficial effect on wear and surface damage.

Preliminary experience showed that the type of bearing-surface material has considerable effect on the ability of gases to provide effective lubrication. Further, moisture availability, condensation of gases, contaminants, and probably other factors affect the application of gaseous lubricants. Also, deliquescence of the iron chloride or other reaction products can cause corrosion of the bearing surfaces.

[3] "The Friction and Lubrication of Solids," by F. P. Bowden and D. Tabor, Clarendon Press, Oxford, England, 1950, p. 229.

The Role of Technological Institutions in the Years Ahead

Financial situation is private education's major problem and threatens the future existence of some of these institutions

By John T. Rettaliata

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Technical institutions play a major role in educating the individuals who become a part of and advance our technology. They are the key element in the understanding of advanced technology, just as the universities have led in the enlightenment of the world throughout the ages. These institutions are well aware of the responsibilities entrusted to them. They accept these obligations, and give assurance that they will execute them in a creditable manner.

TECHNOLOGICAL education, in common with education generally, has many problems, and in the solution of these problems it must have help if it is to continue in its role of mankind's benefactor.

However, private education's major problem is its financial situation. A study conducted by the *New York Times* emphasizes the financial dilemma of most educational institutions. The survey of 810 institutions of higher learning revealed that almost one half of the private ones are unable to balance their budgets. The future existence of some of these institutions is being seriously threatened.

Sources of Income

In general, the major source of income to private colleges and universities is student fees, and many of these institutions are operating at less than optimum enrollments. A principal reason for this is the student trek to the tax-supported institutions because of the tuition differential.

Traditionally, essentially balanced enrollments existed between the public and private institutions of higher learning. In the fall of 1952, however, the tax-supported institutions enrolled 7.5 per cent more students than the private colleges and universities. In 1953 the difference doubled into 15 per cent. It almost doubled again in 1954 when it went to 27 per cent.

The contrast is even more significant in the case of students entering college for the first time. In 1953 the number of such students enrolling in public institutions exceeded those entering independent schools by a significant 43 per cent. In 1954 this figure went to 49 per cent.

This sharp disturbance in the distribution between our dual educational system is viewed with apprehension by thoughtful people. There is fear that an inordinate continuance of this trend will permit circumstances that will interfere with the quality of the educational process. At present, our public universities do an excellent job, and it is felt that the best assurance of continuance is the balancing effect of strong, free-enterprise, private institutions with comparable enrollments.

Another cause of financial distress is dwindling endowment income. At the time that the parents of today's college students were in college, endowment earnings were paying about one third of the cost of operating the nation's private universities and colleges. Today, endowment income pays only about one tenth of the bills.

And, of course, the private colleges and universities have suffered from inflation. The cheapened dollar has resulted in their operating costs almost doubling in the past 15 years. Obviously, survival demands that the gap between income and expenditures be diminished or eliminated. How can this be accomplished?

Corporate Support Stressed

Obtaining additional income through contributions appears to be the most feasible method for solving the grave problem that exists. Such contributions resolve into the categories of alumni, foundation, individual, and corporate support. Since, under our present tax structure, the wealthy individual is rapidly becoming extinct, the colleges and universities must rely principally on the remaining three sources. Of these, corporate support possesses the greatest potential.

In America, where under our free-enterprise system industry has flourished and achieved great stature, it is probably natural to turn to this source of strength when in need. The colleges feel that they have played a role in industry's good fortune, and, consequently, do not consider it inappropriate to approach industry for support in a period when their future is in jeopardy. It is reasoned that better business can continue to be built only if higher education remains strong.

Before business and industry consider the support of

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The recently announced grants by the Ford Foundation totaling a record $500,000,000 to aid 4157 colleges, universities, and hospitals was a magnificent and stupendous act and strikes at a basic problem facing American colleges and universities—teachers' salaries. Of the 4157 institutions listed, the program is allotting $210,000,000 to help raise salaries of teachers in 615 privately supported four-year liberal-arts and science colleges and universities. This is in addition to $50,000,000 appropriated in March of 1955. In making the bequest the Ford Foundation said, "Private and corporate philanthropy can make no better investment of its resources than in helping to strengthen American education at its base—the quality of its teaching." *Editor.*

private higher education, however, they have a right to know whether the colleges and universities have taken all other possible steps to put their houses in financial order. They have a right to know whether educators, being associated with an enterprise where the brink of bankruptcy is considered respectable, have succumbed to this kind of philosophy and, therefore, have not explored all other means of solving the financial problem through their own efforts.

The private colleges and universities are confident that they have explored and executed all such means. A suggestion frequently offered is to reduce expenses. Certainly most institutions have painstakingly followed this avenue until, in many cases, further curtailment would undoubtedly endanger the academic program.

Another consideration that immediately comes to mind is to increase tuition, and this has been done by practically all institutions. In 1940 tuition fees provided 48 per cent of income. Today the figure varies between 55 and 60 per cent.

Across the nation the independent colleges and universities have increased their tuition by an average of 78 per cent since 1940. This increase has created a price differential which is causing more and more students to seek out the less expensive tax-supported schools—a case where private enterprise has difficulty competing with government subsidy.

As a means of producing additional income most institutions have critically examined their endowment-fund investment portfolios. Low-yielding, fixed-return investments have been reduced and common-stock holdings expanded.

While modifications of this sort are beneficial, they still do not solve the financial problem. Harvard University, whose endowment-fund holdings comprise 51 per cent of common stock, is a good example. As a result of the shift to commons, the fund's rate of return on cost was 5.09 per cent last year, compared with 4.55 per cent in 1950, and 4.03 per cent in 1948. In spite of this, however, the investment income covered only 31.4 per cent of the university's costs last year, compared with 42.4 per cent in 1940.

Further, many colleges have intensively developed the support of their alumni. If an institution's own graduates don't render financial assistance, it is difficult to make a strong case that outsiders should. The alumni-fund campaigns have been showing improved results in the recent years. In 1952 there were 270 alumni funds, comprising 608,000 contributors, which produced a grand total of $24,000,000. In 1954 alumni of 352 institutions contributed a total of $63,000,000.

It is believed that this demonstrates that the private colleges have done practically everything feasible to help themselves, before requesting expanded corporate participation in this fight for survival. Fortunately, to an increasing extent, enlightened businessmen recognize the need for corporate support of private education. They appreciate that education, like industry, can be effective only when it operates in an atmosphere of freedom. The best guarantee that this situation will not perish is the perpetuation of our dual system of private and public education. If the independent colleges should disappear, restraint on teaching could soon be expected and standards of quality decline.

Business Has Stake in Private Education

Other cogent reasons for supporting education can be mentioned. On a quid pro quo basis alone business has a stake in private education. Many executives recognize that the benefits derived through research, and the procurement of qualified personnel from the colleges, would obligate industry to reciprocate through financial assistance.

Rendering financial assistance to private institutions also reflects to the advantage of the donor. It is obvious, of course, referring to the afore-mentioned increasing disproportionate enrollments between the public and private institutions, that people are contributing much more to the support of the public institutions—even if they are not aware of it—than they are giving voluntarily to the support of private education.

Public Education Costly to Taxpayers

Because the tax-supported institutions are keeping their tuition charges far below the cost of each student's education and, additionally, since the private institutions, due to lack of adequate financial support, have had to increase their tuition, more and more students are entering the public institutions where taxpayers will be underwriting an increasingly larger number of students and a greater share of the cost of their educations.

This ironic twist should be emphasized. The taxpayer who neglects financial support of private education is automatically increasing what he actually contributes to education through taxes—without the privilege of determining where and how his support is distributed.

This fact was convincingly revealed in Denver two years ago, as a result of the fund-raising efforts of some of the city's leading citizens in behalf of the University of Denver, a private institution. To solve that university's financial problems, it had been proposed that it should be made a part of the state's educational system. Determined that this should not happen, the university's trustees undertook a personal canvass of the city's business firms to call to their attention that it was in

(Continued on page 244)

The Engineer's Greatest Achievement

By Crosby Field

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There is absent from the commerce of the "engineer world" one item of universal commerce in the "pre-engineer world." This item is the trade in human slaves. This is indeed the greatest achievement of the engineer in commerce and industry; the removal of the need for human slavery is in fact his great contribution to the world. How has he accomplished this? By the substitution of cheaper mechanical power for the apparently cheap but relatively more expensive muscle power of the slave.

THE works of the engineer have become so widespread in this Western World in which we live, that rightfully we may call it the engineer world. Certain of the Eastern Nations are now making frantic efforts to become part of this engineer world, but it will be many years before the engineer's works will become a major part of their commerce and industry.

Little more than twice the life of this Society or 150 years ago, the influence of the engineer in the commerce and industry of even our Western World was slight. There had been, it is true, from time to time throughout the preceding ages, an occasional individual whose achievements were such as would today class him as an engineer. Nevertheless, the benefits of his efforts were reserved for only the top economic layer of the social order. Moreover, these efforts were individualistic and intermittent; there was no sustained continuing effort by a group of men educated and trained for the purpose, which group was sufficiently large to cause a diffusion of the benefits of its creations throughout the general population. The present Western World, therefore, can truthfully be called the engineer world, and the Western World 150 years ago and the Eastern World today can properly be termed the pre-engineer world.

Fruits of the Engineer World

Comparison of lists of items of the commerce of the engineer world with those of the pre-engineer world brings forth one striking likeness and two outstanding differences. This likeness is that the wants of human beings through the ages have been much the same; food to eat, skins or cloths to cover the body and to shoe the feet, dyes to beautify the cloth, fire for warmth or cooking, spices to flavor the food; oils, cosmetics, and soaps to pretty the body, and drugs to combat illness; in addition, wood, stone, or other building materials for shelter and munitions for defense against enemies; ships or other equipment for transport, and materials or devices for communication and to make the records of commerce. Energy or power was of course also needed and the largest single supply available was used and traded in universally—more about this shortly.

The first of these two differences is in variety and volume. The engineer in conjunction with scientists and other technological practitioners has added a tremendous number of varieties in each of the foregoing categories. Moreover, he has reduced the cost of production, storage, handling, preservation, and transportation to the point that almost everyone's needs or even wants can be satisfied to at least a reasonable degree. We call this contribution of the engineer the improved "standard of living" of the general population. It contrasts markedly with the standards of living in the pre-engineer world.

In this accomplishment he has interfered with many former channels of trade, and in some instances he has even reversed their flow. For example, ships that formerly carried natural indigo from India to America now carry synthetic indigo from America to India.

Underlying this accomplishment is a far greater achievement; he has almost annihilated man's bondage to space and time—man's former seeming insurmountable obstacles to progress. In this way he has increased immeasurably the rate of flow of all items of commerce.

Great as may be these works, yet his greatest achievement is to be found in the second of the two differences: There is absent from the commerce of the engineer world one item of universal commerce in the pre-engineer world. This item is the trade in human slaves. This is indeed the greatest achievement of the engineer in commerce and industry; the removal of the need for human slavery is in fact his great contribution to the world. How has he accomplished this? By the substitution of cheaper mechanical power for the apparently cheap but relatively more expensive muscle power of the slave.

What Is Slavery?

Slavery is a word so loosely used today that few of us recall its true definition. Slavery is a social system in which a man or an organization has the legal right to use another human being as property. The master owns the slave entirely and completely. The slave has no rights, he is a piece of property to be dealt with by the master as the master might deal with any other piece of property he owns.

The memory of man is short; it is therefore most difficult for us who live in our free engineer world to comprehend that in the pre-engineer world the ever-present existence of human slavery dominates the relationship of nation to nation, class to class, man to man, man to woman, creditor to debtor, master to servant, employer to employee, husband to wife and children. It formed the principal commodity of trade, so valuable that it was

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also the principal cause of war. It darkened not only the acts, but even the thinking of statesmen, politicians, philosophers, humanitarians, and religious leaders.

The Code of Hammurabi. To understand, at least in some degree the difference between these worlds, it is necessary that we delve a little into the pre-engineer world and the history of slavery. Probably the oldest code of law that has come down to us is that of Hammurabi (about 2300 BC—the time of Abraham). A large part of this code was devoted to slavery. Heavy penalties were prescribed for anybody interfering with the slave of another—to inveigle a slave to set even one foot outside his master's home was death, as was the penalty for helping one to escape or even for harboring an escaped slave (12, vol. 1, p. 502).[1]

Slavery as a system was well established long before this period. "Asia had already supplied Egypt with slaves, perfumes, cedar wood, and cedar essences, enameled precious stones, lapis lazuli, and the embroidered and dyed stuffs of which Chaldea retained the monopoly until the time of the Romans" (12, vol. 1, p. 113). The hypothesis that no city civilization of any early time existed on any base other than slavery is substantiated by every archaeological find today! Moreover, the higher the degree of civilization, the greater the number of slaves.

It is interesting to contrast the standard of living of England, when at the time of the Domesday Book the number of actual slaves, not including serfs, was only 10 per cent of the population (11, p. 44) with the Saracen and the Byzantine Empires of the same period where the proportion of slaves was vastly greater. Englishmen were uncultured, ignorant, illiterate, and barbaric, according to the standards of the latter civilizations.

One obstacle to the ready acceptance of the fact that all ancient civilizations were built and maintained by slaves is the enormous number that must have been required. Yet these amazing multitudes were easily obtained by war. Let us examine a few of the statistics the historians give us:

Slavery as a Cause of War. Sennacherib, King of Assyria (705 BC—mentioned in the Bible) after a single campaign against the Aramaen Tribes carried off 200,000 men and women as slaves (12, vol. 1, p. 406).

The Great Pyramid of Cheops required 100,000 slaves for 20 years (13, p. 19). Athenaeus gives the number of slaves in Athens as 400,000, Boechk estimates four slaves to each free man, one single citizen had 1000, another 600, and the father of Demosthenes kept 52 (20, p. 184). Incidently, he ran two factories, a butcher-knife factory with 32 of them, and a bedstead factory with the other 20 (19, vol. 1, p. 504). Quoting Xenophon Memorabilia II-7, Herodotus estimates the number in Sparta as at least 220,000. Thucydides mentions that on one occasion alone 20,000 Attica slaves escaped (Thuc.VII-27) (20, pp. 183–4).

Rome fought Macedonia (219–167 BC) and thus picked up the old empire of Alexander—all dissidents in Greece were either "liquidated" as we would say today, or "transported to Italy to live in captivity." That the number was enormous is evidenced by the fact that Aemelius Paulus after his single victory at Pydna sold 150,000 into slavery (17, p. 167).

Plutarch says that, in his 51 BC campaign to conquer Gaul, Caesar "took by storm more than 800 cities, subdued 300 nations . . . and took a million prisoners to be slaves." (17, p. 180). Although Fuller believes these figures exaggerated, we learn from other sources that after a single victory Caesar sold 150,000 into slavery, after another he sold 90,000, and after another 63,000. We also know that between 146 BC and 220 AD the slaves outnumbered the free men in Rome 3 to 1. In the census taken in Italy under Emperor Claudius (41–45 AD), 20,832,000 slaves were enumerated (6, p. 23), and Gibbon believed "that during this same reign Rome possessed all through her empire a total of 60,000,000 slaves" (20, p. 281–282).

Many Roads to Slavery. Let us interrupt these series of figures for an instant, and inquire as to the source of these slaves. A comparatively few free men became slaves because of some fact other than having been taken captive in war. Among these other ways, were as punishment for certain real or alleged crimes against the state or for indebtedness. For example, many a citizen of Republican Rome called up to serve in the Army, upon his return, would find his business ruined by his absence, so his creditor would await his mustering out to receive him with fetters to be worn for the rest of his life—unless he brought back enough captives or enough gold obtained by their sale to a trader on the battlefield, to wipe out his debt. Patriotism as such had to be victorious to pay in those days!

Again, the eldest son inheriting an estate and finding it after taxes encumbered with debt would first sell into slavery his unmarried sisters, then his younger brothers, and finally, if necessary, himself.

Of course slaves could not marry, but all progeny of a slave, whether by slave or free person, was slave. Slave breeding farms did exist in most ancient cities, but they did not do well. Their operators learned just as did our own negro slave breeders that raising a human being for the market was much more expensive than letting him grow to maturity free, and then kidnapping him. Even when slave breeding did become profitable in peacetime a good war, with its mass kidnapping, would be sure to put it out of business.

Most of the wars of that time were in reality little better than large kidnapping raids. It was either enslave the other fellow or be enslaved yourself. The Roman used the same word for stranger and for enemy, and they meant the same thing to him. Both Nineveh and Babylon undertook wars for the express purpose of procuring slaves (20, p. 102).

"In Arabia . . . the Romans had long mined for gold; their method, the usual one, having been to reduce the nations to slavery to force them into the exterminating labor of their own mines." Pliny ("Hist. Nat." book xii, chapter 18) says that in his day silver from Europe and gold from Arabia were shipped to India and China to the aggregate value of 100-million sesterces (15, p. 18).

The Second Punic War. "The Second Punic War drove large numbers of free (Roman) laborers into cities . . . also (their) enrollment into increasing numbers of legions and the opening up of vast wheat regions in Africa, Sicily, and Sardinia brought with it further need for slaves and the slave markets could be supplied by war. War thus became a necessity of Roman Civilization" (17, p. 146). "The sale of citizens of conquered Corinth, Carthage, and Numantia was profitable, and many of these rebellions and so-called wars were little more than slave hunts" (17, p. 171).

"The stronger nations soon found that slaves were

[1] Numbers in parentheses refer to the Bibliography at the end of the paper, including page numbers for a particular reference.

very useful and many nations made war for the purpose of securing slaves. The nation which could not or would not defend itself soon ceased to exist, and its people became slaves" (13, p. 19). "Often indeed, the chief interest in a war centered upon the kind of slaves who would be brought to Rome. Thus we find Cicero in a letter to Atticus complaining that the slaves whom Caesar would lead captive from Britain would be illiterate" (20, p. 269). In this connection we should note that Caesar's rival Pompey had previously brought to Rome as spoils of his Eastern campaigns multitudes of very highly educated Greeks.

Hurrying down the ages we find that gold and silver were essential to Charlemagne to build and to maintain the Holy Roman Empire (15, pp. 49–50) and this was at the bottom of his relentless wars against the Saxons—he wanted their mines and themselves for slaves to work them (15, p. 14).

In Charlemagne's time slavery was not confined to the mines, but in his dominions it was the universal source of labor, even that of Church lands. For example, about the year 796, he appointed the English scholar Alcuin to be Abbot of Tours, a monastery with possessions so vast that its lands were worked by 20,000 slaves (16, p. 255).

The Slave Trade

The lists of export from the principal ports of the pre-engineer world show that the basis of all their commerce was the slave trade. Sparta, Athens, Cyprus, Samos, Ephesus, Chios achieved a huge volume of this trade in ancient Greece. Some cities specialized, for example, Delos was the market where pirates sold their captives (6, p. 23). The trade of ancient Rhodes was largely slaves (4, p. 21). Of course, Carthage was a great slave center, and the universal hatred of the Phoenician throughout ancient times was due largely to his monopoly of the lucrative slave trade. "The most important branch of Phoenician commerce was the slave trade" (12, vol. 2, p. 342). And when Rome became the mistress of the world her greatest trade was in slaves. It is noted that this trade was so great that instead of slave auctions being held on certain days of the week as was usual in most ancient cities, in Rome every day was a slave-market day.

Throughout the middle ages the slave was the center of Mediterranean commerce. A few cities like Naples specialized in providing markets for the captives of Turkish pirates. The wealth of Venice, the Queen of the Adriatic, was based upon the slave trade (4, pp. 58, 103). Because of her near monopoly on the trade with Byzantium, where that type of slave brought a premium, Venice was known as "the greatest eunuch factory in Europe." In 1453 Constantinople fell to the Turk, and only six years later loud was the complaint in the Venetian Senate about the increasing rarity of slaves, and the honorable senators all too correctly predicted the end of their prosperity. You see, the Pope had recently forbidden the export to the Turk of Catholic slaves, Muhammed II of Mohammedan slaves—this left only a few Protestants and Greek Catholics, like the Russians, for the trade. In 1492 we read of the sale of Russians on the Venetian market, but by 1500 there were only 3000 slaves in the entire city (12, vol. 9, p. 323).

In ancient times Rome imported her slaves chiefly from Asiatic countries, although some came from Africa, Spain, and Gaul. Her import duties, or "Portorium" as it was called, was one eighth of their value for eunuchs, one fortieth for other slaves, and both were subject to an additional 2 to 4 per cent sales tax (3, vol. 25, p. 218).

Prices Paid for Slaves. What have been the prices paid for slaves? It all depended upon the supply and demand. After a successful battle, the price was very low, in peacetime higher. In Britain during the Dark Ages the price of a man was the same as that of a hawk or a greyhound (15, p. 7). In Athens in the Age of Demosthenes an educated slave was not worth more than a well-bred horse (£50 in 1897 pounds sterling); the average hack writer £12; Xenophon gives a price of £8 for a good laborer, but mentions others not worth £2. At the same time Alcibiades spent £300 for a dog—at a time when singers brought £5 and schoolmasters £17. When Alexander the Great captured Thebes he sold 30,000 for £3-3s each. In ancient Babylon a male slave brought £4-10s, and a female slave 57s (1897 pounds sterling) (20, p. 190).

Except in a relatively few instances, generally due to some quirk in the law, the price of a female, age for age and condition for condition, usually ran about half that of a male slave. A historically quite recent example of such an exception is the Octoroon. Because of the laws of the State of Louisiana, this white-appearing girl was legally black and therefore subject to slavery. Consequently, she brought a very fancy price in the slave market, especially when educated and trained to be a companion to a wealthy white master.

The usual prices paid to the Phoenicians were (12, vol. 2, p. 344):

Age 1–5 years	Male, 5 shekels	Female, 3 shekels
5–20	20	10
20–60	50	30
60 plus	15	10

Joseph, it will be recalled was sold for 20 shekels (Joel iii-3). In Genoa or Venice, male slaves brought (12, vol. 9, p. 323):

13th Century	200–300 lire
14th Century	500–1400 lire
15th Century	800 (plus) lire

Captains of Queen Elizabeth I seized Spanish vessels and sold Spanish noblemen at Dover on certain market days at £100 a head (2, p. 438).

In 1685 the Queen of England profited over 1,000 guineas for her private purse by selling to the West Indian Plantation Catholic owners 100 of her Protestant subjects charged with rebellion (12, vol. 20, p. 377).

The prices of negro slaves in the United States followed the same general relationship between the sexes; that is, the man brought more than the woman. In 1828–1832 prime male field hands (age 18 to 25) were bringing from $650 to $700; prime female field hands were bringing $550 to $600. With training, such as blacksmithing or carpentry, a man could bring $1500 or more; women apparently reached top prices as field hands (condensed from reference 14). The reason for this price differential was, of course, that the master was buying a source of muscle power, and the male was usually stronger in that attribute than the female.

In passing, it might be well to point out that the slave owner was not always a white person. In the state of Louisiana in 1860 there were 18,647 free negroes, many of whom owned slaves (14, p. 87).

The Slave—A Source of Energy. The higher price of the male slave and the great increase in the number of slaves as the ancient civilizations grew, emphasize the reason for the existence of human slavery. All energy was muscular, the slave was the predominant source of muscle power. And power was essential for the building and maintenance of the cities which made civilization in the pre-engineer world. In such a world vast numbers of slaves are required merely to supply the most elemental needs of the many and the luxuries of a very few.

Power—the Great Emancipator

In our world, the engineer has substituted mechanical power for the muscles of the slaves. Our profession, in the last analysis, is devoted to the development of the sources of mechanical power from some heat or other engine, including the nuclear reactor, and the machine in which the power is applied for our benefit. As a result, the cost of power has been reduced to a point below that of the cheapest slave. In our engineer world, and only in our engineer world, slavery is uneconomical and, therefore, has ceased to exist. It still exists in the countries today comprising the pre-engineer world. That is the reason our ships transport power-using machines and power-producing plants of all kinds instead of the human slaves they carried during the countless centuries of the pre-engineer world.

Removing the Need for Slavery. Please do not misunderstand; the engineer did not set out to abolish slavery, but by his power-producing equipment and his machines powered by mechanical energy he did remove the need for slavery. This is his greatest achievement in commerce and industry—the engineer removes the need for slavery.

By removing the need for slavery, previously recognized as the essential basis of civilization, he has given the humanitarians the opportunity to abolish its legal status. Although there have ever been a very few who have cried out against slavery, yet the great thinkers and leaders of the pre-engineer world recognized its necessity, and upheld it. Aristotle, who possessed 13 slaves, taught that "the most necessary and valuable property is man"—(Economics Bk I Ch.V) (20, p. 179), and in his "Politics" he defines a slave as "living property." Socrates recognized that slavery was the basis of Athenian civilization and endorsed the theory that it is just to enslave one's enemies (Xenophon Mem. ii-2, p. 2) (20, p. 397–401). St. Paul took slavery for granted and acquiesced in it (Rom XIII—5 EPH VI-5) (20, p. 63). All through the first half of the nineteenth century the southern Ministry in the United States on the whole defended slavery. In 1925 the League of Nations reported that opposition to the abolition of slavery in the Christian nation of Abyssinia "comes principally from the priesthood, which considers itself the guardian of the Mosaic Law and regards slavery as an institution decreed by Jehovah" (23, p. 105).

Ewbank Predicts Abolition. As an example of clear foresight in the effort to abolish slavery Thomas Ewbank should be cited. In his address before the American Ethnological Society in New York in 1860, he says "wherever slavery is rendered commercially impossible by the superior economy and efficiency of inanimate forces," then freedom has to prevail. He defines these inanimate forces as steam, electricity and, in general, heat, and outlines their application as has since been accomplished by the engineer. He continues, "Is there any risk in asserting that if a moiety of the influence and money expended by England and America during the past ten years for suppressing the slave trade had been devoted to the extending of inorganic forces to slave labor, the market prices of negroes in the United States had now been reduced to African standards," which automatically by rendering the price of negroes so low would have eliminated the slave trade (21, p. 30).

Ewbank also suggests the formation of societies devoted to the object of applying the inanimate forces to the uses of man, and hence may be said to have urged in 1860 the founding of the ASME.

The Galley Slave. One of the most vivid examples of the engineers' removal of the need for slavery is seen in the Mediterranean galley. For all the centuries preceding the advent of the engineer's steam engine, the galley had been propelled by slave oarsmen. The galley slave was with us right up to the middle of the nineteenth century before steam completely "took over." Slaves to the number of 60,000 rowed the 300 Phoenician galleys which joined the ancient Persian Navy (12, vol. 2, p. 342). Slaves rowed all the galleys of Constantinople from 500 AD to 1800; and the papal galleys were rowed by slaves till 1800 (2, p. 401). Still later captured American seamen were enslaved to row the galleys of the Barbary corsairs. In 533 the invasion Armada of Belisarius, comprising 500 ships, was escorted by 92 dromons rowed by 2000 slaves (17, p. 311). Venice consumed 40,000 galley slaves in one war against Genoa (2, p. 399). In 1487 Ferdinand of Spain captured Malaga and sold the entire population as slaves—except a special few who were executed or burned (17, p. 540). In the seventeenth century, French galley slaves comprised five classes: Turks, deserters, salt smugglers, genuine criminals, and Huguenots (1685–1717) (1).

Serfdom and Villenage. Space does not permit telling more about galleys—their true stories of cruelty and death have never been equalled in fiction. Even Victor Hugo's "Les Miserables" is mild in its descriptions. Nor can we now dwell upon the related conditions of serfdom, villenage or the like. These were modified forms of slavery in which law or custom could step in and say to the master; this far, and no further. Serfdom was, therefore, a state of slavery limited by law. In slavery, the law recognized the slave only as property, all rights in him were the master's—even the right to live. The master could torture and kill his own slaves at will, limited only by his concern for his loss of property value. If he harmed the slave of another, he was legally responsible to make good the loss to the master, not to the slave. The slave, being property, could own no property—not even the clothing, if any, he wore. The serf could own property, could marry (with permission of his master) and had many other poor rights, but at least he was recognized in the law as being a person, which the slave never was.

Slavery Today

Slavery does exist today in most parts of the world that are still pre-engineer. A brief glimpse is accorded by reading "Forced Labor in Soviet Russia" and the bibliography contained therein (24).

The United Nations Ad Hoc Committee on Slavery appointed by direction of the Council, reported in 1952, that "slavery even in its crudest form is still present in

the world . . ." "It recognized that (it) . . . cannot be abolished by legislation alone . . ." but that the underlying economic and social causes of such practices must be removed (22, pp. 503–505). Again, on August 30–31, 1951, the Representatives were unanimous in deploring the existence of slavery in the twentieth century. All recognized, however "that the problem was a difficult one to solve . . . because of their underlying economic conditions." In other words, the work of the engineer was still missing.

Note, however, that in 1925, the League of Nations Committee on Slavery reported, "Change from slavery to free wage is a transition already in full process of accomplishment in the case of the introduction of modern industrial and agricultural methods"—and only in those places (23, p. 13). In other words, the works of the engineer are beginning to be applied.

And when these quotations say slavery they mean just that, and they define slavery (23, p. 503):

1 "Slavery is the status or condition of a person over whom any or all of the powers attaching to the right of ownership are exercised."

2 "The slave trade includes all acts involved in the capture, acquisition, or disposal of a person with intent to reduce him to slavery; all acts involved in the acquisition of a slave with a view to selling or exchanging him; all acts of disposal by sale or exchange of a slave acquired with a view of being sold or exchanged, and in general, every act of trade or transport of slaves" (see also League of Nations Treaty Series, 1927, vol. LX, p. 263).

Areas of Pre-Engineer Status

Were slavery only the ugly specter of a past age, then we could deal with it purely academically as a matter of passing interest. Unfortunately, most of the world is still in a pre-engineer state, and in it slavery flourishes. Moreover, the governments built up on its basis are strengthening themselves. Apparently, they believe they can control the engineer world by pre-engineer methods. What are the chances of their doing so?

The most hopeful fact history gives us is that although slavery was the basis of all pre-engineer world civilizations, it was also the nemesis of each individual slave society. "Slaves formed the Wealth of (those) Nations; they formed also the Nemesis" (20, p. 326). "In Rome . . . the abuse of property in slaves . . . (was one of the two) chief factors in her ultimate catastrophe" (20, p. 227). The provinces of Rome revolted because of the wretchedness and mortality of her slave system (15, p. 59). "In the year 467 AD the Roman mining slaves . . . joined the army of the Visigoths . . . and in a few years destroyed the last vestige of Roman Power in the Peninsula" (15, p. 79).

Many more examples can be cited. One more may be helpful. Disruption of Charlemagne's Empire was inevitable for "He had built it upon a false foundation, upon the ephemeral fruits of conquest, and the unprofitable and uncertain products of slave mining . . . ." (15, p. 187).

Winning a Free World

In the pre-engineer world, former or present day, stronger nations found that slaves were not only very useful but were essential to improve the standard of living of the masters; and most nations made war for the purpose of securing slaves. "The nation which could not, or would not, defend itself soon ceased to exist, and its people became slaves. The life of a slave was generally worse than death" (13, p. 19).

The presence of slaves brutalized the household of the master; punishment dungeons or rooms existed in every large house; in the smaller homes use was had to the public jailers who were also expert floggers. In these rooms existed torture devices, of which the lash was the least. The whip was used not only on the slave, but on the children, and frequently on the wife. The difference in mental attitude toward all persons between a slave-holding society and a free society is even greater than the difference in their standard of living.

The world has found that the breeding and use of mechanical power-driven metal slaves has become the basis of all engineer-world commerce and industry, just as human slaves were and are the basis of all pre-engineer civilizations.

Although many figures have been given, yet they may all be summarized by saying that in the pre-engineer civilizations the *average* number of human slaves per free man varied from one to ten, every American today has the equivalent on an energy basis of 260 (6, p. 102).

When our showdown comes with the slave empires of today, can our metal slaves made and operated by free men win the victory against the engineer's metal slaves made and operated by slaves? Our generation may witness the answer. The answer is, I believe, that we will, provided we ourselves do not become victims of slavery in one of its hidden forms. Let us not forget, the engineer by himself does not abolish slavery; his great contribution is that he removes the need for slavery. Please join with me, in ever remembering ourselves and reminding others that "the engineer removes the need for slavery."

Bibliography

The Bibliography on "Slavery" is voluminous; much of it devoted to controversy as to its justice. The following references given below on the whole are incidental in works devoted to history. The special references to galley slaves have not been quoted in the text. The Bibliography follows:

When our showdown comes with the slave empires of today, can our metal slaves made and operated by free men win the victory against the engineer's metal slaves made and operated by slaves? Our generation may witness the answer. The answer is, I believe, that we will, provided we ourselves do not become victims of slavery in one of its hidden forms. Let us not forget, the engineer by himself does not abolish slavery; his great contribution is that he removes the need for slavery. Please join with me, in ever remembering ourselves and reminding others that "the engineer removes the need for slavery."
The Author.

1 "The Splendid Century," by W. H. Lewis, Wm. Sloane Associates, 1954.
2 "The Mediterranean," by Emil Ludwig, Whittlesey House, 1942.
3 Encyclopedia Britannica, thirteenth edition, 1926, "Slavery."
4 "A History of the Business Man," by Miriam Beard, MacMillan, 1938.
5 "Economic History of Europe," by S. B. Clough and C. W. Cole, D. C. Heath Company, 1946.
6 "A Short History of Technology," by H. G. Bowen and C. F. Kettering, Thomas Alva Edison Foundation, 1954.
7 Encyclopedia Britannica, thirteenth edition, 1926, "Serfdom."
8 "English Social History," by G. M. Trevelyan, Longmans Green, 1949 (see also reference 27).
9 Encyclopedia Britannica, thirteenth edition, 1926, "Villenage."
10 "History of Power," by R. E. Bruckner.
11 "Authoritarianism and the Individual," by H. W. Metz and C. A. H. Thomson, Brookings Institution, 1950.
12 "The Historian's History of the World," Ed. Henry Smith Williams, The Outlook Company, New York, N. Y.; The History Association, London, 1904–1905, 25 vols.
13 "Outlines of the World's Military History," by Col. Wm. A. Mitchell, Military Science Publishing Co., Harrisburg, Pa., 1935.
14 "Isaac Franklin, Slave Trader and Planter of the Old South," by W. H. Stephenson, Louisiana State University Press, 1938.
15 "Money and Civilization," by Alexander Del Mar, Geo. Bell & Sons, York St. Covent Garden, 1886.
16 "Charlemagne From the Hammer to the Cross," by Richard Winston, Bobbs-Merrill, New York, N. Y., 1954.
17 "A Military History of the Western World," by Maj. Gen. J. F. C. Fuller, Funk & Wagnalls, New York, N. Y., 1954.
18 "Slave 1E-241," by John H. Noble, The Devin Adaire Co., New York, N. Y.
19 "The Ancient Lowly—Vol. I," by C. Osborne Ward, Chas. H. Kerr & Co., 1888.
20 "The Nemesis of Nations," by W. Romaine Paterson, E. P. Dutton & Co., New York, N. Y., MCMVII.
21 "Inorganic Forces Ordained to Supersede Human Slavery," by Thomas Ewbank, originally read before the American Ethnological Society; Wm. Everdell & Sons, New York, N. Y., 1860.
22 "Yearbook of the United Nations, 1951."
23 League of Nations, Publication 1925, Report of Temporary Slavery Commission, July 13–25, 1925.
24 "Forced Labor in Soviet Russia," by D. J. Dallin, Boris I. Nocolaevsky, Yale University Press, New Haven, Conn., 1947.
25 "History of the English People," by R. J. Mitchell and M. D. R. Leys, Longmans Green & Co., 1950.
26 "America and European Diplomacy to 1648," by F. G. Davenport, Annual Report for 1915, American Historial Association.
27 "Illustrated English Social History," by G. M. Trevelan. Longmans Green & Company, 1952, four volumes; see also reference (8),
28 "Pax Romana and World Peace," by Lawrence Waddy, W. W. Norton & Co., 1951.

Pertaining to Galleys

"The Seventeenth Century," by Jacques Boulenger, W. Hememan, London, 1920.
"Diary" (entry, Oct. 7, 1644), by John Evelyn, Simkin, Marshall, Hamilton Kent & Co., London, n.d.
"Histoire de La Marine Francaise," by Chas. de LaRoncierge, vol. V, Plon Nourritt & Cie, Paris, 1934.
"Monsieur Vincent, Aumonier des Galeres," by Henri Lavedan, Plon Nourritt & Cie, Paris, 1928.
"Madeleine de Scudery," by Dorothy MacDougall, Mathuen & Co., London, 1938.
"The Memoirs of a Protestant Condemned to The Galley of France for His Religion," by Jean Marteilke, translation by James Willington, O. Goldsmith, Griffiths & Dilly, London, 1758.
"Apostle of Charity," by Theodore Maynard, Allen and Unwin, London, 1920.
"An History of the Sufferings of Mr. Lewis de Marolles and Mr. Isaac Le Fevre Upon the Revocation, etc." by Joseph Priestly, Birmingham, n.d.
"Lettres de Mme. de Sivigne," ed. L. Ainie Martin, 6 vols., Paris, 1876.

Role of Technological Institutions in the Years Ahead

(*Continued from page 238*)

their self-interest to make annual gifts in support of the university.

With figures supplied by the Colorado Public Expenditures Council, the trustees demonstrated that if the university went on the tax rolls it would cost Colorado's industries a considerable sum of money in additional taxes.

One corporation insisted on knowing exactly how much more, annually, it would have to pay. It was shown that, based on 1952 tax records, this additional sum would be $67,000. It is reported that this corporation made a gift of $10,000 immediately, as its initial contribution to the insurance that the university would not go on the tax rolls.

More and more companies are engaging in support of private education. Many others, recognizing the necessity, are investigating procedures for giving. They have resolved the question of "whether to give," and are working on the solution of "how to give."

Corporate Contributions Increasing

It is interesting to observe the increasing corporate acceptance of the necessity for contributions to education as demonstrated by actual company giving practice. In 1936 total corporate contributions for all philanthropic purposes amounted to $30,000,000, which was equivalent to 0.39 per cent of net income before taxes. Currently, these figures are approximating $400,000,000 and 1.0 per cent, respectively, or about one fifth of the total tax-exempt allowance permitted by the federal government.

It is estimated that education, this year, will receive approximately $100,000,000 from corporations, or about 0.25 per cent of net taxable income. In order to promote survival of private education on an adequate basis it has been recommended that this figure be 1.0 per cent. If this latter rate had existed in 1954, the total profits after taxes of about $17,800,000,000 would have been reduced by about $175,000,000.

The colleges and universities feel that their mission is worthy, and that they can continue to make important contributions to the progress and security of the nation by providing a continuing supply of adequately educated manpower. They desire, therefore, that aid rendered them not be regarded as charity, but rather as a "factory expense," a legitimate cost of doing business.

And the incentive for assistance is compelling for, as has been stated by the Council for Financial Aid to Education, "what happens to American education will eventually happen to America."

How Radiographic Inspection of Lead Linings Can Reduce Future Maintenance Costs

Sensitive and positive techniques are being used to delineate surface and subsurface defects in lead-lined vessels for corrosive service

By W. Skiba[1] and V. P. Bracken[2]

Esso Standard Oil Company, Bayway Refinery, Linden, N. J.

LEAD-LINED equipment in severe corrosive service has been a source of maintenance and service problems for decades. These problems resulted from corrosive materials penetrating the lead through various openings and slag inclusions. The method of inspection for these faults normally has been an acid etch of the lead surface. This acid-etch technique does not always expose all possible points of future failures.

Radiographic examination of lead linings has been found feasible. This technique, with proper interpretation of the resultant radiographs, is more sensitive and positive than the acid-etch technique. The application of this inspection technique will result in a unit with a higher service factor and reduced maintenance costs through trouble-free operation.

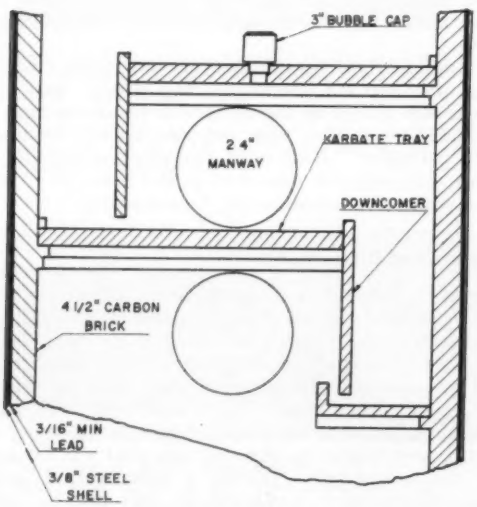

Fig. 1 Section through 7-ft-diam × 36-ft-high tower

Problems Call for New Method

Lead failures occurred in a 7-ft-diam × 36-ft-high tower designed for handling 45 per cent sulphuric acid at 275 F. This tower was fabricated of homogeneously bonded lead on steel and lined with carbon brick, Fig. 1. It contains trays and bubble caps of carbon material, Fig. 2.

The failures occurred in areas adjacent to the 24-in manways. With the initial failure the manway cover was removed, and permanent repairs were made by removing a Karbate sleeve and necessary carbon brick, welding the corroded hole in the tower shell, and rebonding the lead lining. The subsequent failures were temporarily repaired without opening the tower by plugging the openings with Alkor cement.

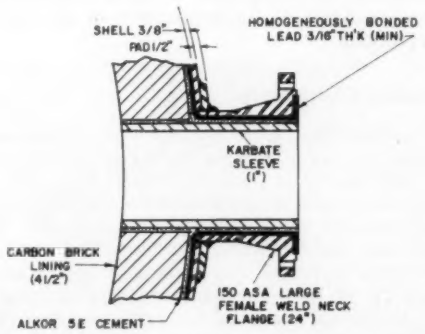
SHELL 3/8"
PAD 1/2"
HOMOGENEOUSLY BONDED LEAD 3/16" TH'K (MIN)
KARBATE SLEEVE (1")
CARBON BRICK LINING (4 1/2")
ALKOR 5E CEMENT
150 ASA LARGE FEMALE WELD NECK FLANGE (24")

Fig. 2 Section of typical nozzle construction

Each repair required unit down time. During the initial 4 months of unit service, the number of shell failures increased to five. The resulting service factor for the unit could not be tolerated. It was decided to investigate the condition of the tower lead lining.

The normal acid inspection of lead would have required the removal of all tower internals and the carbon-brick lining. Unit down time of 5 to 6 months was estimated for this type repair. Sales requirements dictated that this loss in production could not be tolerated and investigations were conducted to locate rapid, positive, and accurate means of determining sources of future problems.

Inquiries were made into the possible application of nondestructive methods. The use of dye penetrants, radioactive tracers, and radiography were suggested.

Dye penetrants were rejected since their use would require removal of the tower internals—the same as with the acid-etch technique. Use of radioactive tracers was discarded because of the high level of radioactivity

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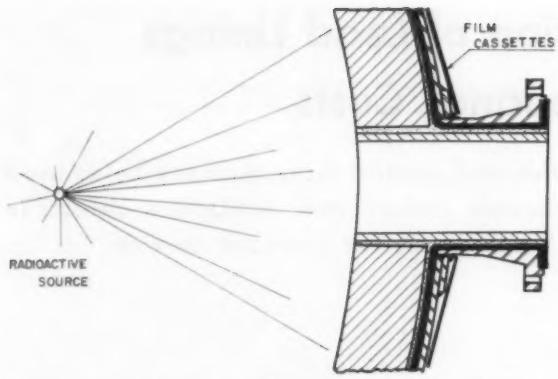


Fig. 3 Arrangement for radiographing shell openings

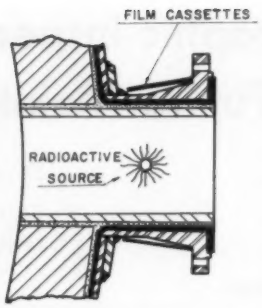


Fig. 4 Arrangement for radiographing necks of attachments

necessary. The use of radiography was the remaining method to be considered. A review of possible sources of information on radiography revealed that no information was available on the application of this technique to this problem.

Developing a Technique

The radiographic technique for this application was developed by experimenting in the laboratory with a $^1/_4$-in. lead sheet laid on a $^3/_8$-in. steel test plate. Successful radiographs were obtained of different diameter holes drilled to various depths in the lead. The exposures were made utilizing a cesium-137, 5-curie source and du Pont Type 506 fine-grain film at a source film distance of 36 in. The exposure time necessary was 7 hr. Additional successful test exposures were made by placing carbon brick over the lead and steel plates to simulate the tower construction.

A field test in the 7-ft-diam × 36-ft-high tower was carried out utilizing a portable 250 kvp x-ray unit instead of a radioactive source because of the shorter exposure time required for the x rays. Excellent correlations of the indications in the radiographs with the actual defects in the lead were obtained by scraping and burning the lead to pin point the defects. The smallest honeycombing, crack, hole, or slag inclusion can be uncovered with this technique.

Following the successful test work, a systematic coverage of the tower was initiated. Because of the bubble cap-tray spacing in the tower and the large areas to be covered, it was decided to utilize radioactive isotopes with resultant gamma-ray radiographs. Another factor influencing this decision was the requirement for excessive x-ray exposure time because of water absorption by the brick.

Fig. 3 indicates the method that was used to radiograph the shell area adjacent to all manway necks. The various radioactive sources and strengths that were used were cobalt-60, 500 millicurie; iridium-192, 2 curie; and cesium-137, 5 curie. These sources and radiographic films such as du Pont Type 506, Eastman Kodak "No Screen," and Ansco "A" used at a source-film distance of up to 36 in. resulted in maximum exposure times of 12 hr. The use of fine-grain film was preferred to the coarser-grain types since the larger film grain was found to interfere with the delineation of small-size defects that were depicted on the gamma-ray radiograph. The composite thickness of the lead carbon-brick-lined vessel shell (equivalent to $3^1/_4$ in. of steel) was a large factor in determining the exposure time. Film exposure holders 14 in. × 17 in. were placed adjacent to the 24-in-diam manway shell opening. By adjusting the location of the radioactive isotope for proper source-film distance, all film around one manway was exposed simultaneously. Match marking of the overlapping film permitted accurate defect location. Shell areas adjacent to all nozzle attachments were radiographed in a similar fashion.

Spot checks of the lead lining in other shell areas away from attachments were done individually or at the same time that exposures were made in areas adjacent to manways.

In order to radiograph manway and nozzle-neck linings, the method shown in Fig. 4 was used. The source was placed on the center line of the opening and film-exposure holders were wrapped around the nozzle-neck periphery. Because of the short source-film distance, the exposure time was in the order of 10 to 15 min, when using a cesium-137, 5-curie source.

Results and Discussion

Figs. 5 through 8 illustrate the correlations of the radiographs and actual defects exposed in the lead lining.

Defects found through radiographs are shown in Fig. 5. This photograph portrays the actual condition that the radiographic examination can delineate through $4^1/_2$ in. of carbon brick, $^3/_{16}$ in. lead, and $^1/_2$ in. carbon steel. Adjacent to the corroded hole in the vessel shell can be seen a heavily corroded area that was uncovered by the radiograph. Within a short period another leak would have developed at this point. Typical honeycomb porosity that exists in the lead lining is also portrayed at the top left corner of the photo. This property is detrimental since entrapped gases can expand and rupture the lead surface. Radiography is the only means that will uncover this subsurface structure.

Fig. 6 is a radiograph of a manway neck through a combined thickness of 1-in. Karbate, $^1/_4$-in. lead, and $^1/_2$-in. carbon steel. The source-film distance and exposure time were 12 in. and 15 min, respectively, when using a cesium-137, 5-curie source. Indicated are lead crack, steel corrosion, and honeycomb porosity. Fig. 7 shows a photograph of the same area after the Karbate sleeve and the lead near the crack were removed and the corroded steel uncovered.

Subsurface slag defects, such as shown in Fig. 8, are critical. This slag has a dendritic structure whose branches sometimes reach the surface. This material is very susceptible to corrosive attack and can be a source of failure.

One hundred per cent radiographic surface inspection of this 7 × 36-ft tower during fabrication would have cost $2500. This figure represents $4^1/_2$ per cent of the

Fig. 5 View showing corroded hole in shell and adjacent corroded shell first revealed by a radiograph. Upper left is the typical honeycomb lead structure that can be located by this technique. Radiography through 4 1/2 in. of carbon brick, 3/16 in. of lead, and 3/8 in. carbon steel delineated these defects.

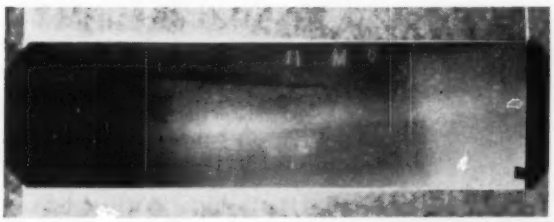


Fig. 6 Radiograph of manway neck through 1 in. Karbate, 1/4 in. lead, and 1/2 in. carbon steel outlining lead crack, corroded steel, and honeycomb porosity. (View in Fig. 7 shows corroded steel.)

installed cost of the tower. The use of radiographic quality control in preference to the 100 per cent coverage would substantially decrease the cost of the inspection.

Many Uses for Method

The present technique of inspecting lead linings by an acid etch is inadequate for locating all defects. Based on a review of the remaining methods of nondestructive testing and the results of the radiographic technique, the radiographs are more sensitive and positive for locating defects in lead linings. The cost of this technique is not excessive when considering the reduction in unit down time and gain in production that can be realized.

Equipment which is presently in service and contains secondary linings can be inspected with a minimum of trouble by utilizing radiographs.

This technique can be used for quality control during the fabrication of lead-lined equipment. Spot checks would be made to determine if correct procedures are being followed by the fabricator.

Use of this technique for inspection of lead-lined pipe, valves, and special equipment is possible.

Acknowledgments. Mr. M. L. Leith and Mr. E. B. Lambert of the Industrial X-Ray Engineers, together with several assistants from their Woodbridge office, were extremely helpful and co-operative in furnishing equipment, assistance, and technical aid for the development of this technique.

Fig. 7 View of corroded steel under lead crack shown in Fig. 6. Lead thickness of 1/4 in. was burned away in vicinity of crack to expose corroded steel.

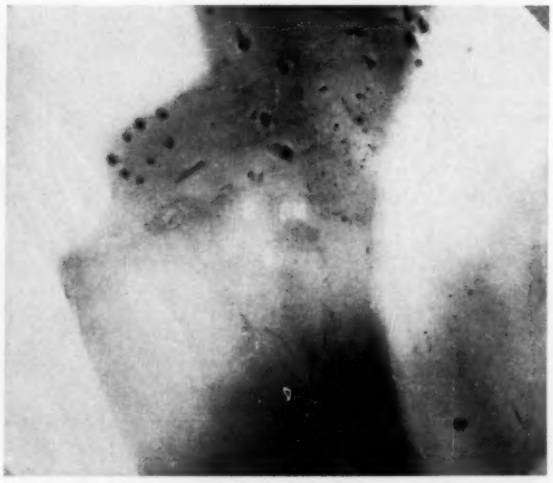


Fig. 8 Radiograph of shell area immediately adjacent to manway opening. At left is outline of 4 1/2-in-thick carbon-brick lining and at right is indication of manway reinforcing pad. Black circle in lower right is reinforcing-pad weep hole. Toolmarks resulting from brick removal are indicated by large markings at top while smaller pin-head marks are lead inclusions. Encircled areas are lead slag under which steel corrosion was found.

Briefing the Record

Abstracts and Comments Based on Current Periodicals and Events

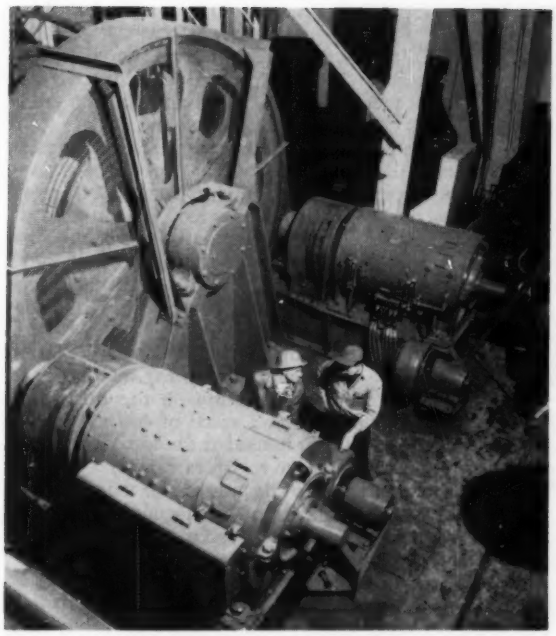
J. J. Jaklitsch, Jr., *Associate Editor*

World's Largest Shovel

The Mountaineer, world's largest shovel, rises 160 ft into the air (the height of a 16-story building). The machine has a 60 cu-yd dipper (90 tons), a boom 150 ft long, a dipper handle 92 ft long, a dumping diameter of 290 ft, and a dumping height of 97 ft.

COMPLETION of the world's largest shovel, as tall as a 16-story building, weighing 5,500,000 lb, and costing $2,600,000, was announced at Cadiz, Ohio, recently by Hanna Coal Company, Division of Pittsburgh Consolidation Coal Company. Called the Mountaineer, it is said to be the largest unit of mobile land machinery ever constructed in this country. Engineers of the Marion Power Shovel Company, Marion, Ohio, fabricators of the machine, estimate that it is at least 100 times as large as the power shovel commonly seen on neighborhood building projects. This machine will be used to remove earth and rock overburden, averaging 90 ft in depth, from the $4^1/_2$-ft-thick Pittsburgh coal seam in Eastern Ohio. Although the four large shovels which Hanna had had in service for several years at their open-cut mines are among the largest ever built, they are not capable of removing overburden averaging as much as 90 ft in depth. The new machine makes possible the recovery of millions of tons of coal not recoverable with the smaller machines.

Fabrication of parts for the machine started in October, 1954, in Marion's shops. This was preceded by many months of engineering by engineers of Marion, Hanna, and General Electric (the latter supplying the major electrical equipment for the machine).



This is the inside of the world's largest shovel which began operation recently in bituminous-coal fields near Cadiz, Ohio. Engineers inspect two of the four General Electric 450-hp d-c motors which power the shovel's 60-cu yd bucket.

The three-passenger automatic elevator, which is installed in the 6-ft-diam center pin around which the upper portion of the shovel revolves, is unique. An elevator has never before been installed in any excavating shovel.

The dipper, or bucket, of the machine has a capacity of 60 cu yd (some 90 tons). One dipper-load would fill a room 10 × 20 × 8-ft high. The shovel will make a complete cycle of digging overburden, making a 180-deg swing, depositing overburden, and returning for another load once every 45 sec. At this rate the machine will handle approximately 14,000,000 lb of material each hour—almost three times its own weight. The dipper handle to which the dipper is attached is 92 ft in length.

After each filling of the dipper with overburden, the top portion of the shovel revolves, and the load is deposited in the void left by the previous removal of a strip of coal. The shovel's 150-ft-long boom and its 92-ft dipper handle make it possible to deposit this overburden some 290 ft away, and to stack it in piles almost 100 ft high.

From the ground to the top of the platform attached to the boom, the shovel rises 160 ft into the air—approximately the height of a 16-story building.

Each of the 8 crawlers, or "cats", upon which the shovel stands and moves, measures 8 ft high, 23 ft long, and 54 in. wide, and each crawler weights 60 tons. Each of the four pairs of crawlers is powered by a 250-hp motor.

A unique feature of the Mountaineer is a 3-passenger automatic elevator manufactured by the Otis Elevator Company. Such equipment has never been included in any shovel ever manufactured. This elevator is installed in the 6-ft-diam center pin around which the upper portion of the machine revolves. In boarding all previous machines of this kind, it has been necessary to climb a stairway and to stop the machine while the person on the stairway stepped from the stationary (lower) deck to the revolving (upper) deck. Stopping the machine is objectionable, and the hazard of a person's being injured by the machine starting prematurely, or by the person's attempting to step onto the revolving deck while it is in motion, has always been a problem. The elevator on the new machine makes it possible to board the machine safely while it is in operation.

The Mountaineer has a total lifting power of some 500,000 lb (250) tons. The two hoist cables which are used to pull the dipper upward through the earth and rock overburden are $2^1/_2$-in-diam, steel rope, 580 ft long, manufactured by the American Steel and Wire Company, a subsidiary of United States Steel Corporation. herringbone driving gears which operate the twin hoist-cable drum, are 13 ft in diam. The hoisting operation is powered by four 425-hp motors.

Four automatic, electrically controlled, hydraulic leveling jacks are located at each corner of the lower frame. The purpose of these jacks is to keep the revolving upper portion of the machine absolutely level while operating, even though the machine might be standing on uneven terrain.

Each of some 500 bearings of the shovel is greased automatically. A pump, controlled by an electric timing device pumps lubricants through a piping system to each of these bearings at predetermined intervals.

Only one man is required for actual operation of the Mountaineer. He will control all operating functions of the machine by the use of 2 foot pedals, 2 hand levers, and 1 whistle cord. In addition to the operator, one oiler will be used to check the performance of the lubrication system and to perform minor repair work. As it becomes necessary to move the machine forward, one man on the ground will aid in operating and steering the crawler mechanism. A bulldozer will work on the coal

seam with the shovel at all times to push fallen earth and rock to where it can be reached easily by the dipper. The machine will operate three, 8-hour shifts per day.

Interfloor Conveyer

A FAST-TYPE interfloor conveyer that automatically loads, transfers, and delivers heavy loads between as many as six floors has been announced by Gifford-Wood Company of Hudson, N. Y.

The automatic conveyer is said to perform one of the longest transfer jobs between floors ever achieved for heavy loads. The new system, it is reported, moves loads twice as fast as any other conveying method used for the same job. The first installation to use this system estimates it is saving $25,000 a year in handling costs because of its new conveyer.

It is designed for use in warehouses, textile mills, and other installations where long interfloor transfer hauls of heavy loads present serious handling and cost problems.

Resembling an elongated ferris wheel in its transfer sequence, the fully automatic system consists of a tray-type elevator conveyer, with trays spaced 25 ft apart between two parallel roller chains; loading and unloading entrances at each floor, on opposite sides of the conveyer shaft; safety fire doors, side-sliding or up-sliding, at each entrance; automatic loading and unloading "fingers" at each station; and a complete set of operating and safety controls.

In operation, trays pick up loads from entrances on one side of the shaft, carry them over the top and down to the predetermined discharge station on the other side of the shaft. Trays move at a speed of 48 fpm, driven by a hydraulic electric unit housed at the top of the shaft.

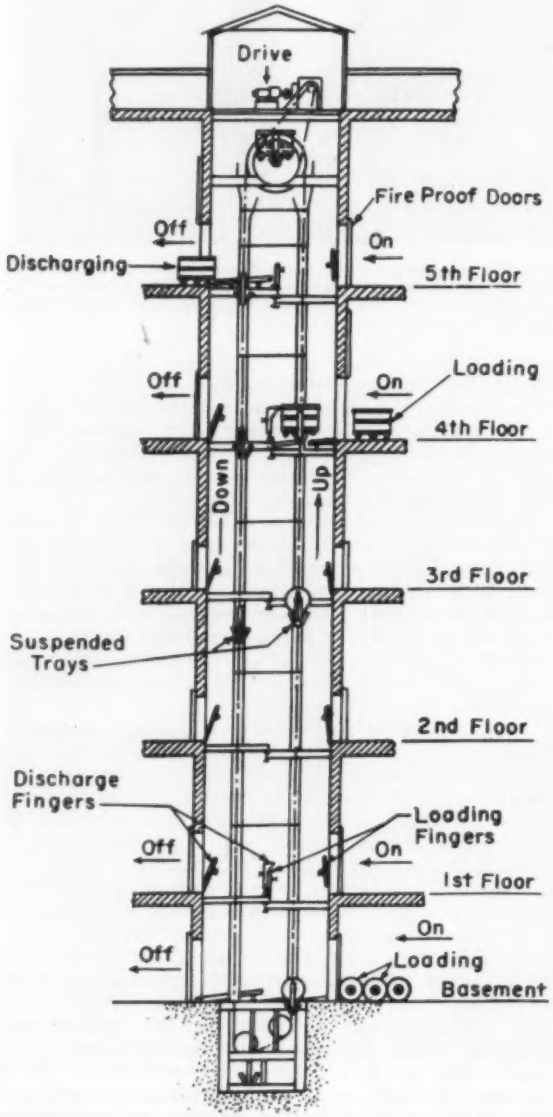
In order for the conveyer to operate, only one door on the load side and one on the unload side may be open. When ready to start the transfer sequence, an operator at the unload station pushes a signal button indicating that unload fingers are in receiving position.

At the loading station the operator pushes the start button, which moves the conveyer tray into loading position. Loading fingers automatically move the load onto the tray. The loaded tray then moves up the shaft, over a series of chain sprockets at the top of the shaft and down the other side.

Unload fingers at delivery point are in receiving or down position; all unload fingers at other floors must be in up position. Load is removed from tray and deposited on platform at designated unload station. An electric-eye mechanism at each unload station prevents pileup of loads at platform; if passage is blocked by other loads, the electric eye stops the movement of the elevator and prevents unload until passage is cleared.

Push-button stations at each operating floor are equipped with start buttons, red pilot light, and indicator lights showing the position of unload fingers at each floor—green for up, red for down. An emergency safe-run switch at each floor can stop the entire transfer sequence at any point.

Limit switches are installed on doors at each loading point and on loading fingers to insure exact loading and smooth transfer sequence.



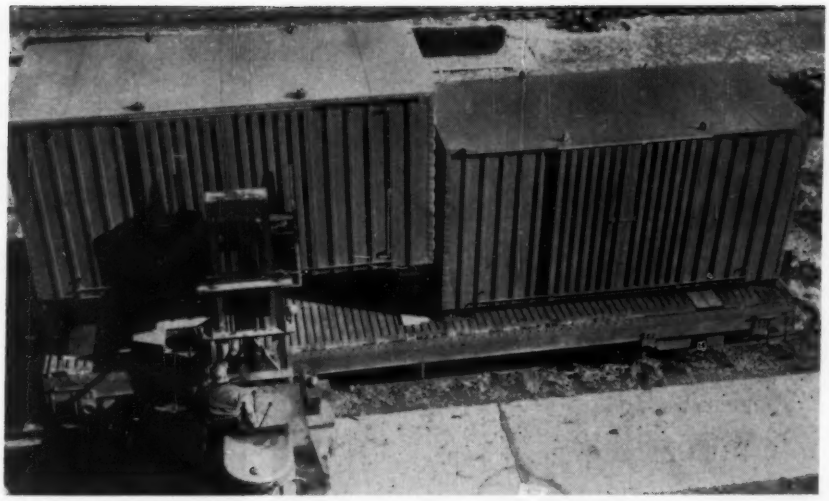
Sketch showing Gifford-Wood fast tray-type interflow conveyer

Convertible Freight Car

A NEWLY designed railroad car, which can be converted to almost any type of freight car, was revealed recently by the American Car and Foundry Division of ACF Industries.

Called the "Adapto," this "all-in-one" basic car is a low-cost, interchangeable, lightweight car of superior riding qualities. Equipped with standard couplers, it weighs about 23,000 lb and it costs only about one half that of standard types of freight cars with comparable equipment.

Features of the four-wheel, 35-ft-long car include fixed axles, air-cushioned suspension, rubber draft gear, roller bearings, and a self-cleaning floor. In comparison, today's 52-ft-long flatcar has eight wheels, friction bearings, no air-cushioned equipment, and weighs 56,000 lb.



Air-cushioned suspension, roller bearings, rubber draft gear for better riding qualities, and less damage to freight are some of the features of the Adapto, ACF's multipurpose freight car

These new features and the radical design give the Adapto passenger-car riding qualities, thereby providing extra protection for lading. The car is able to carry more than 70,000 lb, more than three times its own weight, compared to the average freight car's ability to carry approximately twice its own weight. This has been accomplished by design rather than by use of lightweight metals.

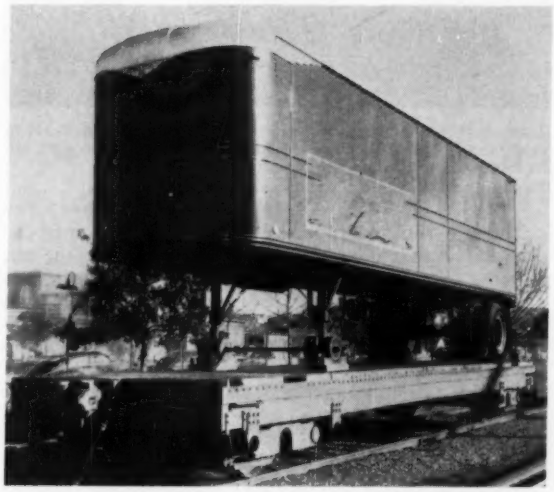
The basic all-in-one flatcar lends itself to box, container-hopper, gondola, tank car, hopper car, caboose, and to "piggy-back" service. This is achieved by the interchange of removable superstructures on the car's platform, which has automatic leveling valves to keep the platform loading height constant, regardless of load.

In addition to the flat car, ACF will supply the containers, tanks, gondolas, hoppers, and other superstructures, so that railroads may make these readily available at freight terminals for quick conversion, depending on the requirements of the shipper.

Two 17-ft containers, or four 8-ft containers, on the basic flatcar will make up the boxcar. Transportation of freight from shippers' door to receivers' door is therefore facilitated. The containers can be lifted off the flatcars and onto waiting trailer-trucks by crane or fork-lift truck. Easy loading and unloading, as well as the convertible feature, is expected to cut idle time of cars in terminals and sidings. Because of the convertible feature of the car, additional savings to railroads are expected through reduced switching and car-handling costs in classification yards.

Other types of cars to which the basic car can be converted are refrigerator cars, using two mechanically refrigerated compartments per car; tank cars, using two detachable tanks; container cars, with hopper boxes or containers; gondola cars, using two standardized gondola compartments; cars for piggy-back service, capable of carrying trailers up to 35 ft in length. Adaptations to other types of freight cars are currently being developed by ACF.

Greater operational efficiency and economics in railroad freight transportation are made possible by the fact that there is nearly 35 per cent less dead weight per ton hauled. The Adapto need never travel empty, since a railroad can sent a 35-ft trailer on the basic flatcar to its destination, then convert the same car into a two-compartment boxcar for the return trip.



The Adapto, built by ACF, is a low-cost, lightweight 35-ft-long flatcar. Adjustable platform has provisions for interchanging attachments for quick conversion to gondola, boxcar, refrigerator, tank car, or piggy-back service.

Damage to lading also will be reduced by the air-cushioned suspension, by double-acting rubber draft gear, by cushioned hold-downs for various attachable units, and by virtue of the fact that many damageable goods will be confined in the standardized compartments that will keep cargo from shifting.

Torque Control Impactool

AN AIR-OPERATED Torque Control Impactool which will run a nut to any desired torque, then automatically shut itself off, has been developed by Ingersoll-Rand, New York, N. Y.

Torque requirements for these diesel-engine main bearing stud nuts is 500 ft-lb. Size 5340T Torsion Bar Torque Control Impactool is shown in use here.

Running up a truss member using $^{7}/_{8}$-in. high-strength bolts—470 ft-lb minimum torque required. Size 5340T Torsion Bar Torque Control Impactool is being used.

The new tool incorporates the first application of the torsion-bar principle to torque control. While the nut is being run to required torque, the Impactool operates at normal power and speed, but when required torque is reached and nut-running resistance is equal to the stress present in the torsion bar, the impact mechanism rebounds instantly and trips a rubber-faced shutoff valve.

Besides combining precision control of torque with the power and speed of Impactool operation, the new tool has the following advantages:

1 The torque setting is simple. It can be set easily and quickly by using a jig which turns a torsion bar and calibration collar to the desired reading against rigid splines on the torque bar adjusting sleeve. The tool can be set to the required torque in a few seconds.

2 Torque setting remains constant for any nut-running operation until the adjustment is changed. Releasing the trigger resets the tool automatically to the same torque for the next nut.

3 The torque control is consistently accurate.

4 No need for pressure regulators, since the Impactool operates at full power and speed.

5 The tool eliminates "over-torque" through the automatic shutoff.

6 The operation is reversible with full power in either direction.

7 Maintenance is low, since there is no clutch to wear, slip, or require adjustments.

8 Runs nuts fast, operators are not afraid to open throttle wide.

Since the torsion bar torque control does not depend on the operator's sense of timing, the tool can be used accurately by inexperienced operators without any special training. All that is necessary is to set the tool and pull the trigger.

Accuracy of the Torque Control Impactool is shown by a test made in a customer's own shop. The job was to run an oil pan plug with a metallic gasket to a torque within a 35 to 45 ft-lb range. On 280 readings on three consecutive days, every reading fell within this range, and actually 79.9 per cent of the plugs were run within a 5 ft-lb range. As many as 28 per cent of the plugs were exactly at the desired 40 ft-lb torque.

The tool comes in two sizes. Size 5040T Torque Control Impactool will be especially useful in general industry, since it is relatively small and easily handled. It has two torsion bars available. One torsion bar has a maximum torque of 60 ft-lb; the other has a maximum torque of 90 ft-lb. The Size 5340T Torque Control Impactool is preset at 320 ft-lb when shipped from the factory, and can be adjusted easily up to a maximum of 550 ft-lb. This larger size has been developed for steel-construction nut-running in the building of industrial plants, office buildings, and bridges, as well as for heavy bolting-up work in general industry.

Tube-In-Strip Mill Products

A NEW mill product in the form of a single strip, or sheet, of solid copper, brass, or aluminum in which tubes are inflated to desired running lengths in a variety of shapes or sizes has been developed by Revere Copper and Brass Inc.

The product, designated Tube-In-Strip by Revere, is

said to have almost limitless and immediate applications in the heat-exchange field, including refrigeration and air conditioning, chemical, food, and petroleum processing, automobile radiators, water heaters and coolers, gas heaters, radiant panel heating, and electronics, among others.

Made of one piece of metal only, the coils and sheets of Tube-In-Strip were described as not discernibly different from the standard strip and roll products normally produced in the rolling mill.

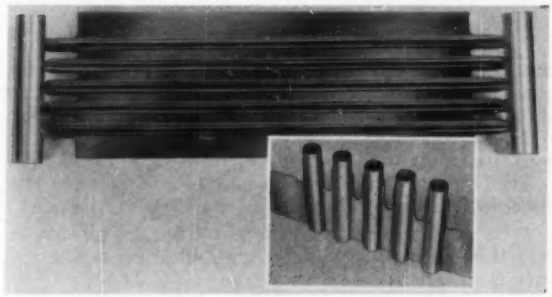
The only difference is that the new material has incorporated within it expandable portions which can be inflated by the user into continuous running lengths of tube of whatever size and spacing or combinations of sizes and spacings might have originally been designated. Except for the expandable portions, the metal is a solid strip of metal derived from a suitably treated casting and the product does not consist of two pieces of metal brazed, welded, and rolled together.

The metal can be stamped or drawn into desired shapes prior to the expansion of the channels. The expanded channels can be made circular in section, or during the expansion operation the metal can be forced into dies for the purpose of producing other than circular sections.

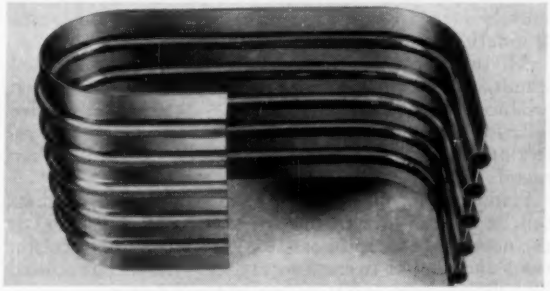
It is also possible to inflate channels on one side of the strip or sheet only, leaving the other surface flat.

The basic method of producing this material is covered by pending patent applications and manufacturing procedures have been developed for copper and brass, the copper-base alloys in general, aluminum and aluminum alloys, zinc, and other ferrous and nonferrous metals.

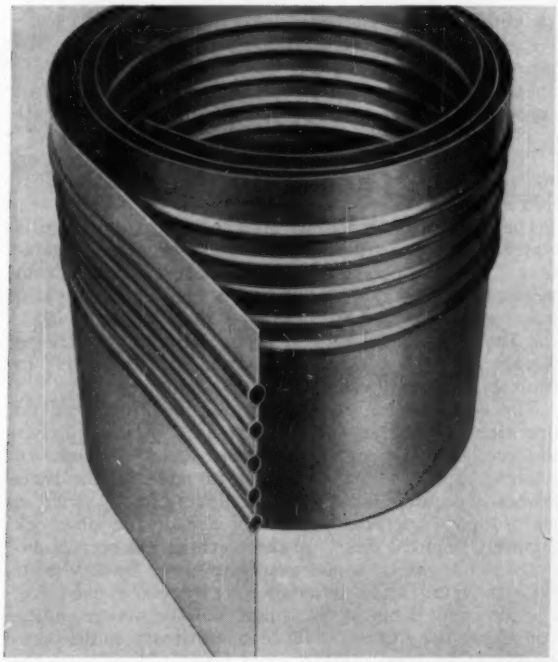
Tube-In-Strip, according to Revere, can be furnished



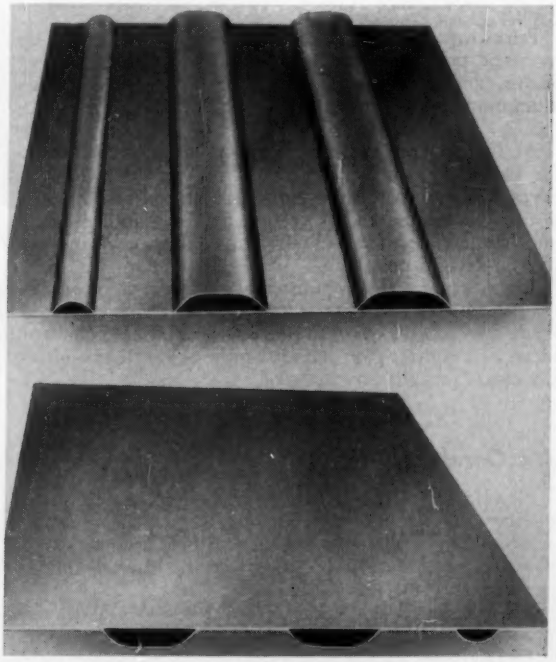
A suggested manifold assembly of Tube-In-Strip with a close-up of the end preparation with web cut away, shown in inset



Inflated Tube-In-Strip has been formed on multiple-die hand bends after inflation using normal tube-bending techniques



Tube-In-Strip can be inflated in a coil of any desired length. This new Revere mill product is ordinarily shipped uninflated in coils. Lower half of coil in the picture has been uninflated.



Two views of one section of Tube-In-Strip formed for possible use as an evaporator shell or shelf. Note that this product can be inflated on one side only by expanding in appropriate dies.

exactly as other sheet-metal mill products of the company, in long coils or in cut flat sheets in widths up to 16 in. at present and wider later, the determining factor being the size of the casting billet from which the product is rolled to its desired width or gage.

Tube spacing, it was explained, can be generally as close as 1/4 in. and even closer in some instances, and as widely apart as the width of the metal permits. Inside diameters of the tubes can vary from approximately 3/16 to 5/8 in. inclusive, when unexpanded. Tube wall gage can vary from 0.0025 in. to whatever the inflation equipment permits.

A feature of the new product is the fact that tube diameters can be varied within a single piece of metal—made all alike if desired, or with each adjacent tube of different size, or with one side flattened, these variations affording unlimited design opportunities.

Inflation techniques are flexible and generally simple. For example, for thin-walled tube air pressure may be entirely adequate while for heavy walls hydraulic means of inflation may be better.

All tubes in a given width of strip can be inflated simultaneously or as desired, it was said. Free inflation produces a wholly round tube. A profile die, or free inflation between flat plates, holding the metal in restraint, is used for dimensions and contours other than round.

Stamping, forming, bending, and drawing operations can be performed on Tube-In-Strip before inflation, or the new product can be inflated before bending, perforation, and similar operations and then further processed by common pipe and tube-bending techniques.

Tube-In-Strip can be joined by means of normal commercial techniques. Manifolds, for either series or parallel flow, are easily produced either before or after inflation, and return bends can be brazed, soldered, or welded readily.

Prices for the new product call for a nominal mark-up over the price of sheet, roll, or strip of corresponding width, gage, and length in copper and its alloys and aluminum, as called for on the full catalog trade price list.

At these prices the new product offers opportunities for major economies, Revere claims, because the user saves first, in cost by buying tube and strip together, already fabricated to his design, rather than separately and, second, because Tube-In-Strip makes new and improved designs possible.

In that regard, it was pointed out that the web between the tubes conducts heat faster, and that the vastly increased structural strength made by the inflated channels mean that lighter gage metals can be used with resulting savings in weight and in price.

Air Conditioning

Nearly $10 billion worth of large air-conditioning and refrigerating systems will be installed in the buildings and industrial plants of the nation during the next 10 years as part of the accelerating trend toward an air-conditioned America.

This was predicted recently by Charles V. Fenn, vice-president of Carrier Corporation's Machinery and Systems Division, speaking in Syracuse, N. Y., at the introduction of three major new Carrier product lines, all of which are expected to produce substantial cost reductions in the installation of very large central systems.

The greatest markets for large air conditioning will be in office buildings, factories, stores, apartment houses, hotels, and hospitals, with industrial-plant systems expected eventually to lead all the rest, he declared.

Referring to existing office buildings as currently the biggest single source of business in the field of large air conditioning, Mr. Fenn said it had now become essential that owners of every major structure of this kind provide complete comfort for tenants if they are to maintain "Class A" status. He estimated the total future volume for such contracts as about $3 billion.

He described the air conditioning of modern industrial plants as equally "inevitable" in order to boost production efficiency in a highly competitive economy, and forecast sharp increases to come in this field. As an indication of the immense industrial potential, he pointed out that there are some 25 to 50 sq ft of manufacturing floor space for every square foot in present-day office structures.

Carrier's Machinery and Systems Division manufactures and markets air-conditioning and refrigerating equipment for the larger applications requiring cooling capacity generally above 100 tons. A ton of capacity represents the cooling effect which would be produced by a similar amount of ice melting over a 24-hr period.

The Division's major new products, shown for the first time, included the following:

1 A new hermetic centrifugal refrigerating machine which is designed for quiet vibrationless operation and easy installation.

Centrifugal machines, originally developed by Carrier in 1922, chill water to provide the cooling effect for the majority of large air-conditioning and industrial-process refrigeration systems in use today.

The new hermetic features electronic controls with completely automatic "push-button" operation.

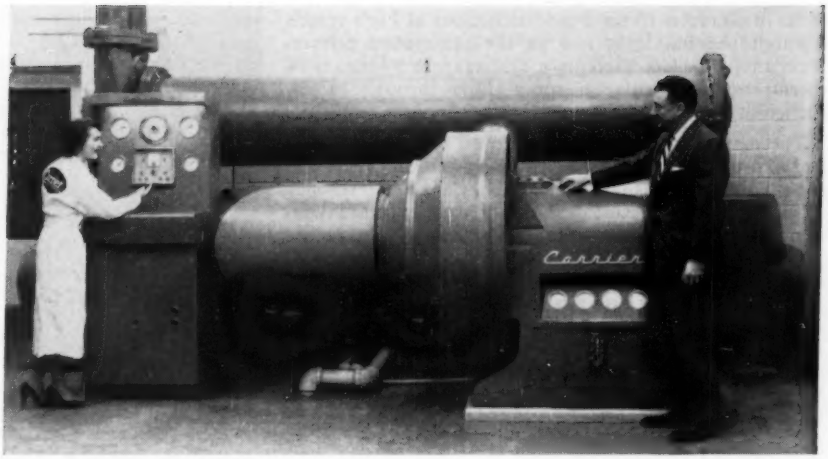
The machine requires no foundations and is easily adaptable to rooftop locations which can bring additional savings in installation, and in rental space many times used for the air-conditioning equipment. It will be available initially in capacities from 100 to 325 tons.

2 A new "push-button" absorption refrigerating machine, also designed to produce a substantial reduction in installed costs.

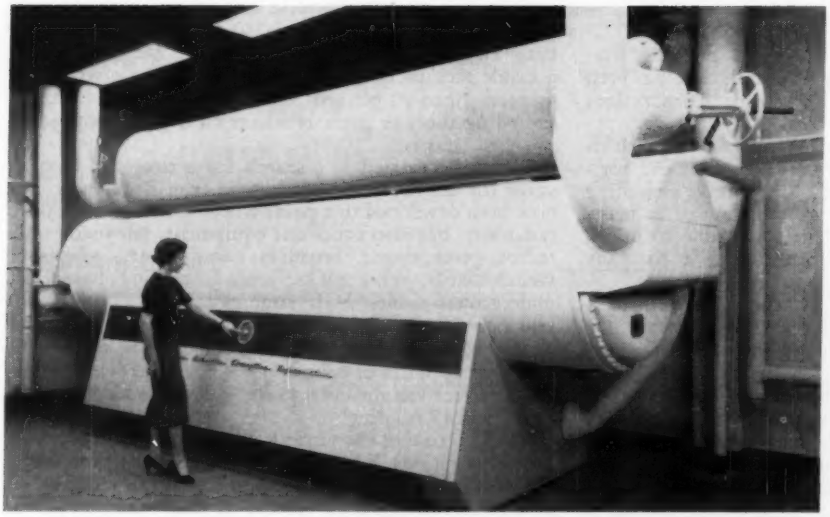
The absorption machine, like the centrifugal, chills water for air-conditioning or industrial-process refrigeration. But it operates on heat energy, usually from steam, has no major moving parts, and employs plain water as a refrigerant. Developed by Carrier in 1945, the absorption unit, because of its extreme lightness in weight and lack of vibration, led the way "upstairs" to rooftop location of central cooling equipment.

The new electronically controlled machines need no operator and virtually no maintenance. Although they are available in sizes ranging from 100 to 700 tons of cooling capacity, the entire set of maintenance parts normally required for the largest model can be carried in an ordinary briefcase. Much of the on-the-job work formerly required to set up the machine has been eliminated since most connections are now factory-made within the unit and smaller sizes are shipped in one piece.

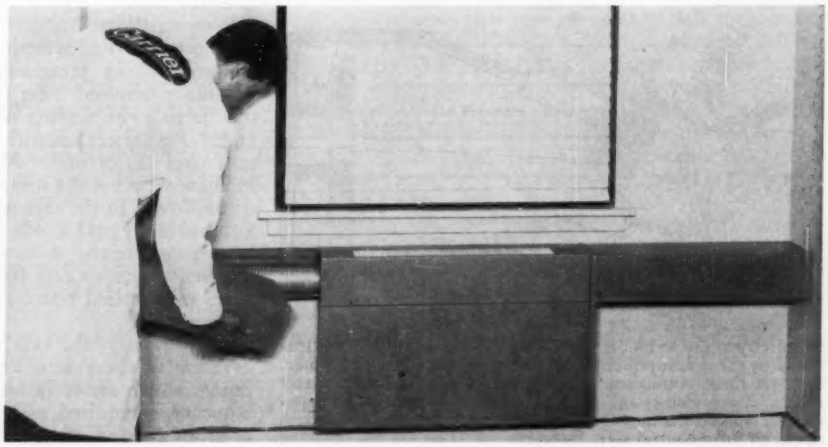
3 A new line of Modular Weathermaster units, considered the greatest advance in multistory, multiroom-building air conditioning since Carrier developed the Conduit Weathermaster high-velocity induction system in the 1930's. The system uses small-diameter circular



Charles V. Fenn and Miss Carol Reed look over newly designed hermetic centrifugal refrigerating machine for use with multistory-building and other large air-conditioning installations. The compressor and electric motor, hermetically sealed in a single shell, provide simplified installation at lower cost, and eliminate the need for foundations.



Automatic absorption refrigerating machine, one of a new line of large-capacity units manufactured by Carrier Corporation that use the heat energy from steam to produce cooling. Made in capacities from 100 to 700 tons, they provide chilled water for air-conditioning and industrial-refrigeration systems.



Modular Weathermaster units for use with Carrier's Conduit central air-conditioning system in multistory, multiroom buildings. As shown, simple enclosures conceal conduit "runouts" bringing conditioned air at high velocity, and piping for chilled or warm water, all supplied from a central plant, to the room apparatus.

ducts or conduits to send conditioned air at high speeds through the building, and at the same time permits occupants to select their own temperature by means of thermostatic controls on room units through which chilled or warm water is circulated.

The new units have been developed to slash the time and effort needed to put the room-equipment portion of such central systems into place. They are also fashioned to meet the many varied demands of architectural layout in new and existing structures.

One line of models, designed for new buildings with extensive glass areas, is only 12 in. high and 11 in. deep and can fit at the base of the large window sections. Another type of Modular Weathermaster unit can be hung readily from the wall under the smaller windows normally found in older buildings without disturbing baseboards or electrical outlets. A wide selection of well-styled and functional enclosures is available which can be assembled as a completely "built-in" part of the building architecture.

Low-Voltage Wiring Device

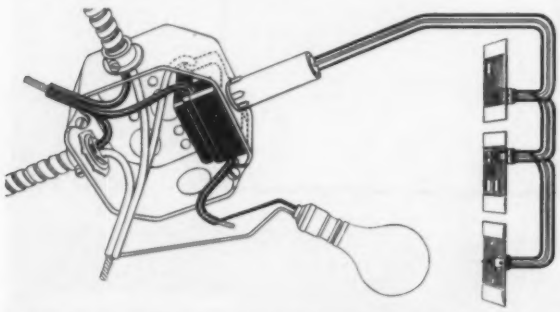
A LOW-VOLTAGE wiring device which provides simplicity, economy, and flexibility of installation, has been introduced by the Pyramid Instrument Corporation, Lynbrook, L. I., N. Y.

With this new device, called Remcon (a relay with its own miniature built-in transformer) architects and engineers can now specify economical low-voltage switching to control any light or outlet from as few or as many locations as desired. It is equally applicable to home, institutional, and industrial construction, a company spokesman said.

Installation is simple, since Remcon requires no centrally located external transformer. Each circuit is a separate self-contained unit completely independent of any other. All the contractor has to do is fit a Remcon unit into the outlet box and match the three wires of the unit to the three wires of the switch. Since only 6 volts are required to activate the outlet, No. 18 bell wire replaces the heavy BX cable normally run from outlet to switch. He can just as easily install additional switches at desired locations and connect them in like fashion to the same Remcon unit.

In factories, for example, the device gives individual switching control at each lighting device. A switch panel in the foreman's office will enable him to control all the lights of the sections under his charge as needed.

In the office, the switches allow all lights to be controlled from one master panel. Anyone returning after hours can light a path to his own office, switching on only those lights needed.



Simplicity of the Remcon low-voltage switching circuit is illustrated by these components—a relay with built-in transformer, No. 18 three-conductor thermoplastic wire, silent contact switch, and switch plate. Each relay has its own source of low-voltage power, fits into the average outlet box, and eliminates the need for a central transformer.

Robotester

AN AUTOMATIC tester, called the Robotester, for checking industrial machines and electronic equipment, was announced recently by Lavoie Laboratories, Morganville, N. J.

Said to be faster, lighter, more compact than any other similar tester, the Robotester can also be manufactured at a cost at least half the price of the few current models in existence and has for the first time eliminated completely the complex "black box" or switchboard hitherto necessary for checking equipment.. Using a punched tape to program test points and parameters, the Robotester performs up to 120 complete circuit measurements per minute and has a capacity of 240 test points per setup. Between any two of 240 points, there are over 57,000 possible measurements or tests per setup. It will pick up from 70 to 90 per cent of failures or defective parts, excluding tubes or gross breakage through a dropped or smashed chassis.

Originally started in a search for a time and money-saver for testing radar equipment, the Robotester has now been developed to a point where it will test not only radar sets, but also other test equipment, television sets, radios, computors, broadcast equipment, telephone switchboards, relay racks, aircraft cabling harnesses, underground cables, SGIP communications and fire-control networks, railroad control systems, gun directors, and virtually any electronic or nonelectronic equipment operated by wires or tubes.

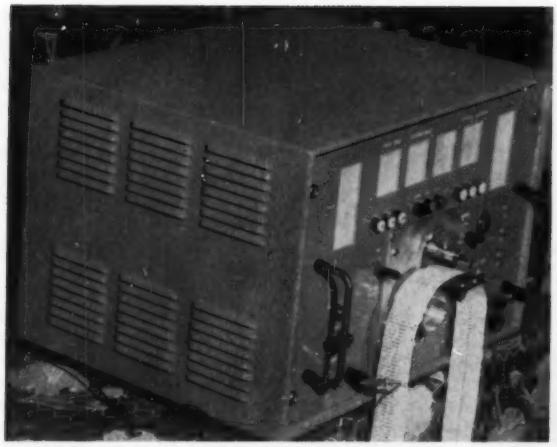
The tester weighs only 45 lb, is 20 in. wide, $13\frac{1}{4}$ in. high, and 18 in. deep.

The function of the tester is to determine whether correct connections have been made, correct components installed, and whether parts are themselves not defective. It checks resistance to ground at each tube socket or terminal strip point in sequence, passing to the next point if within preset tolerance, stopping and warning if in error.

Essentially the Robotester is an automatic resistance-measuring device, selecting any two points (or point-and-ground) in prearranged sequence, measuring the resistance between them in either polarity, and passing or rejecting the reading on an individually preset tolerance. Pass-reject control may be on a basis of $\pm X$ per cent over X, or under X. On rejection, signal lamps indicate whether the measurement is too high, passable, or too low. In the case of a reject, the Robotester stops automatically and holds until released by an operator, who may note the point of rejection.

Twenty-four sockets are provided for a like number of tubes or terminal boards, with up to 10 test points per socket.

In operation, the tape, prepared from the schematic diagram of the system under test, first selects the two points which are to be tested, in any order. No special sequence is required. The test is ordered from A to B, or from B to A, thus determining the polarity of test



Robotester for automatically testing industrial machines and electric equipment

(useful in checking front-to-back resistance of diodes). The first two significant figures of the standard resistor are then selected and the number of zeros added. Tolerance (5, 10, 20 per cent) and limit (less than, ±, greater than) are then added. The entire test is set up within $^1/_2$ sec.

Punching of the tape is accomplished by means of a small manual punch, approximately the size of a desk stapler, by clerical-grade personnel.

Titanium Industry

THE titanium-metal industry, in 1955, overcame its 1954 technical difficulties and again spurted forward on a steeply rising trend line which is expected to continue through 1956 and 1957, according to T. W. Lippert, manager of sales and technical service, Titanium Metals Corporation of America, New York, N. Y. Dollar value of mill products is estimated at $60,000,000 for 1955, with sales of sponge metal accounting for an additional $30,000,000. For 1956, dollar value of mill products will likely exceed $120,000,000 and separate sponge may account for more than $40,000,000. Production of mill shapes—bar, billet, sheet, strip, wire, and extrusions—is estimated at 1900 tons for 1955, some 46 per cent above the 1954 record of 1300 tons. The 1955 mill output was divided about 54 per cent sheet and strip and 46 per cent bar, billet, and extrusions.

Current government estimates show probable 1956 requirements for mill products ranging from 4000 tons to 4500 tons, thereby indicating that fabricators will be under extreme pressure to more than double their record 1955 activity. The four fabricators have been expanding mill facilities in preparation for the rush of high-priority demands, and no significant delivery lags are anticipated.

The 1955 industry production of titanium sponge, the pure intermediate metal from which mill products are made, is estimated by the largest producer, Titanium Metals Corporation of America, at 8000 tons, up almost 50 per cent from the 5370-ton level of 1954, and almost four times greater than the 2240 tons of 1953. For the first three quarters of 1955 the General Services Administration, at the direction of the Office of Defense Mobilization, continued its purchases of sponge in excess of mill-product requirements. Total accumulations for this temporary sponge reserve available for resale, amounted to about 6300 tons by October, 1955, as against a total of about 2890 tons reported at the end of 1954.

Because of the rapidly increasing demands for mill products evidenced by early fourth quarter, 1955, the government ceased all purchases for its sponge inventory, and the year ended with sponge output and demand for mill products in relatively reasonable balance.

During the year, Titanium Metals operated its sponge plant at Henderson, Nev., at full 3600-ton yearly capacity. DuPont is reported to have operated its 3600-ton plant at near capacity, and initial pilot deliveries were reported from the 7500-ton Electro-Metallurgical Company plant (Ashtabula, Ohio), the 1800-ton plant of Dow Chemical Company, (Midland, Mich.), and the 6000-ton Cramet, Inc., plant (Chattanooga, Tenn.). The last three plants are scheduled to come into full production at various times late in 1956.

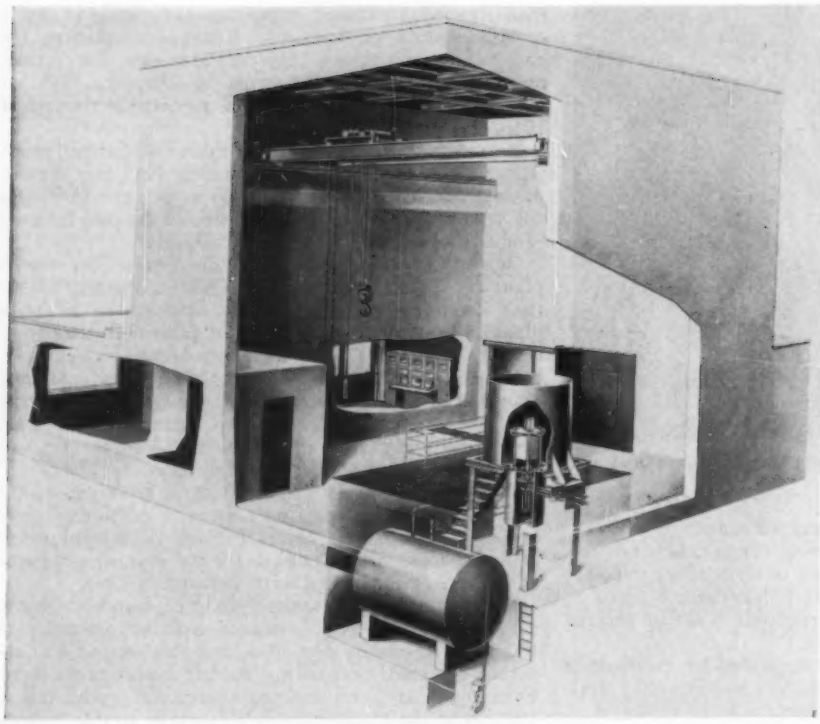
The Japanese busily expanded their titanium-sponge activities in 1955, exporting the major portion of their output to the United States for sale at market price. Total Japanese sponge imports for the year are estimated at 500 tons, as compared with 225 tons in 1954.

Great Britain's sole sponge producer, Imperial Chemical Industries, achieved virtual capacity operation of 1500 tons yearly by late 1955, and this output was absorbed by rapidly expanding aircraft requirements there. Even more significant was the semiofficial report, late in 1955, that the Russians were designing sizable quantities of titanium into their advanced military aircraft.

All through 1955, output and constantly improving production know-how exerted classic influence on price structures. On April 1, Titanium Metals Corporation of America cut 55¢ off the $4.50 sponge price, and lowered mill products from $1 to $3 per lb. On Nov. 1, 1955, DuPont announced a 20¢ per lb additional sponge reduction, and three weeks later (November 23), Titanium Metals cut the sponge selling price an additional 30¢ per lb (to $3.45 per lb) and again reduced various mill products from 80¢ to $3.50 per lb. Therefore 1955 saw sponge decline about 23 per cent and finished mill products an average of about 19 per cent.

Not only was 1955 a significant and encouraging year for titanium in the market place, but equally dramatic accomplishments were being scored on the technical front particularly as regards sponge quality and the development of sound metallurgy for mill products. Whereas sponge quality was a subject of constant scrutiny in 1954, there was so much improvement in 1955 that the subject lost interest. As to basic alloy metallurgy, the industry accommodated itself to customer specifications on uniformity of chemical and physical properties in general more stringent than apply to the much more mature structural metals.

Since its industrial birth five years ago, the titanium industry has successfully won its way on a strength-weight supremacy by offering annealed sheet and bar alloys. The industry now is on the threshold of truly outstanding advancement into heat-treatable alloys, having spectacular strengths per unit of weight. Such alloys will be formed readily in a soft condition, and then heat-treated to give the reliable and very high-strength parts being designed into all advanced military aircraft.



Artist's conception of the reactor criticality facility which ALCO Products, Inc. is building at its Schenectady, N. Y., plant. The nuclear laboratory will cost about $230,000 fully equipped. Shown, *left* to *right*, are the counting room, fuel-storage vault, and the reactor room. The laboratory's control room can be seen behind the reactor room. In the foreground are the reactor tank, reactor core, and control-rod drive mechanisms. The water-dump tank and basement sump are under the reactor.

Nuclear Briefs . . .

Nuclear-Research Reactor

Massachusetts Institute of Technology has selected ACF Industries of New York to design its nuclear-research reactor, according to Dean of Engineering C. Richard Soderberg who is a Fellow of ASME.

Part of the funds for the reactor are already available, Dean Soderberg said. If the rest of the funds are secured, construction will begin once the Atomic Energy Commission and other authorities have given their approval. Construction work would also be done by the ACF Industries, through its Nuclear Energy Products Division. Final decision on a site has not been made.

The reactor will have a power of 1000 kw, the same as that planned for a reactor being constructed on the University of Michigan campus, and it will operate at a temperature of only 104 F—"cool" compared to reactors which produce atomic power.

The M.I.T. reactor, which will be the first to be constructed in New England, will be used for training students in nuclear engineering and for research in such fields as medical therapy; solid-state physics; sterilization of food; biology; testing of industrial materials; and engineering of future reactors.

Reactor Criticality Facility

Plans for construction of a reactor criticality facility at Schenectady have been announced by ALCO Products, Inc. To be built and equipped at a cost of about $230,000, the nuclear laboratory will be completed in May of this year. It will be located on the Mohawk River in the company's main plant.

The reactor facility will be used for nuclear experiments in connection with ALCO's contract for design and construction of the Army Package Power Reactor. To be one of the first nuclear plants in the nation engineered exclusively for power generation, the APPR is now under construction at Ft. Belvoir, Va.

Zero-power experiments, necessary before the APPR can be placed in operation, will be conducted in the laboratory. In these tests nuclear-fuel elements to be employed in the Army plant will be used. However, in the Schenectady experiments, the power level will be kept to one watt, hence the term "zero power." In comparison, the operating power level of the APPR is 10,000 kw.

Fast-Neutron Breeder Reactor

The Power Reactor Development Company, a nonprofit corporation, has been formed to design, construct, and operate a developmental fast-neutron breeder reactor, it was announced by The Babcock & Wilcox Company, one of the 26 firms involved in the project.

The new organization will carry out the atomic-reactor power-plant project initiated by The Detroit Edison Company and a number of other electric power, manufacturing, and engineering concerns including B&W. This project was proposed last March as a part of the U. S. Atomic Energy Commission's Power Demonstration Reactor Program. The AEC announced on Aug. 8, 1955, that the proposal provided an acceptable basis for negotiations under that program.

The new company was organized to consolidate the efforts of those having an interest in breeder-reactor development. Most of the companies now involved in the proposed construction project have been engaged in atomic power-plant research and development.

Experimental Automobiles

Five new experimental cars, ranging from a rakish sports car to a sophisticated advanced-design town car, joined the recently announced gas-turbine Firebird II passenger car as features of the 1956 General Motors Motorama. The experimental cars were unveiled during

the Motorama held Jan. 19–24, 1956, at New York's Waldorf-Astoria Hotel. (See photos on pages 260–261)

The design influence of the experimental Firebird II, announced publicly Dec. 19, 1955, is evident in the styling of the five other cars—the Chevrolet Impala, Pontiac's Club de Mer, the Golden Rocket by Oldsmobile, Buick's Centurion, and the Cadillac Eldorado Town Car, it was pointed out by Harlow H. Curtice, president of General Motors.

Dream Cars Feature Safety

"Our 1956 group of 'dream cars' represent a new high in automotive design for passenger comfort, convenience, and safety," Mr. Curtice said. "The aerodynamic styling adds an exciting look of tomorrow to each of the cars."

"Through the display of these cars in the Motorama we again are taking our futuristic automobile-design ideas to the public for an advanced look," he pointed out. "As in the past, we will be listening carefully to what people have to say about them—not only what they like but what they don't like."

Following its New York Premiere, the Motorama appeared in Miami, Fla., Feb. 4–12. Other appearances for the Motorama are scheduled for Los Angeles, Calif., March 3–11; San Francisco, Calif., March 24–April 1; and Boston, Mass., April 19–29.

All the 1956 experimental cars, including the Firebird II, were designed under the direction of Harley J. Earl, GM vice-president in charge of styling staff, who 18 years ago originated the idea of building dream cars to test new styling and engineering features.

Firebird Gas-Turbine II Passenger Car

The design theme for all the cars is graceful simplicity, with long flowing lines predominant. The Firebird II's aerodynamic design sets the pace for the look of the 1956 experimental cars and the theme is carried through the entire line.

As a successor to the original Firebird, a single-seat gas-turbine passenger car built two years ago for GM for experimental use on test tracks, the Firebird II incorporates into its design, progress in safety, economy, convenience, and comfort.

It is a four-passenger car and has been operated successfully on America's public highways as well as having been tested on proving-ground tracks. One of the engine's main innovations is a regenerator or heat exchanger which recaptures over 80 per cent of the heat from the exhaust gas and uses it to heat incoming air from the engine's compressor.

The regenerator thus gives Firebird II a fuel economy (miles per gallon of kerosene) approaching that of a conventional gasoline-burning piston engine.

Theoretical Electronic Highway Predicted

Further, it is designed throughout for adaptability to use on an electronic highway of the future, a concept of highway travel which, GM says, is entirely possible.

The instrument panel of the Firebird II houses controls for two-way radio operation, a television viewer screen with synchronization controls, a small closed-circuit television setup with camera in the rear and screen on the panel for use as a rear-view mirror replacement, transmission levers, air-conditioning controls, and buttons and switches for ignition, starter, lights, and other accessories.

The electronic—or television—screen and controls, actually incorporated into the Firebird design, would allow the car to "beam in" on a theoretical electronic "Safety Autoway" depicted on film in the 1946 GM Motorama. Electronic pickup coils are designed into the front of the car on either side of the nose in order that the control-tower frequency on such a highway of the future could be received by the Firebird. The process accomplished by the driver and car on such a highway would be similar to that completed by a pilot flying a plane "on the radio beam." Also on the instrument panel are push-button controls for the emergency brakes.

The steering control of the Firebird retracts against the instrument panel when the Firebird II is under automatic electronic control and pulls out to normal position for manual operation.

General Description of Firebird

The Firebird II is 52.75 in. high, 70.5 in. wide, and 234.75 in. long. The wheel base is 120 in. and the tread is 60 in. front, 57 in. rear. It weighs 850 lb.

The body skin of the Firebird is made of brush-finished titanium, a use to which that "wonder metal" never before has been put. It is silvery gray and appears on the Firebird in its natural color.

The unit housing the electronic pickup coils at either side of the nose of the Firebird II serve a triple purpose. Besides housing the coils, these units contain air inlets to the oil cooler and larger inlets for engine air. Just above and behind these units are the headlights. The headlights extend horizontally from the body on either side. When not in use, the headlight units are retracted into the body. On the end of the retractable units are turn signals which house rotating reflector bulbs. These rotating bulbs have powerful beams and as the turn indicator is flicked on, the lights indicate, in a bright, sweeping beam, the direction intended. The hood is raised and lowered vertically and is hinged at the back below the windshield, allowing easy access to the engine compartment. On the top of the hood, small engine air outlets are provided. These open away from the windshield and serve as flaps to reduce wind noises and deflect bugs and other particles in the air.

At each side of the Firebird II, below the windshield and behind the front fender, are passenger air inlets. When the air conditioning is turned on, these flap inlets open allowing air to flow into the passenger compartment. Rear air inlets are located at the nose of each of two 18-gal fuel tanks located on either side of the car beneath the rear fender. These open toward the front of the car when the air conditioning is on and, with the help of two blower fans located inside the body, cool the condenser of the air-conditioning unit. The flaps here again protect against foreign particles being swept in with the incoming air.

Because the window roof panel opens electrically with the insertion of a key in a door slot, no outside handles are needed and the car doors are smooth.

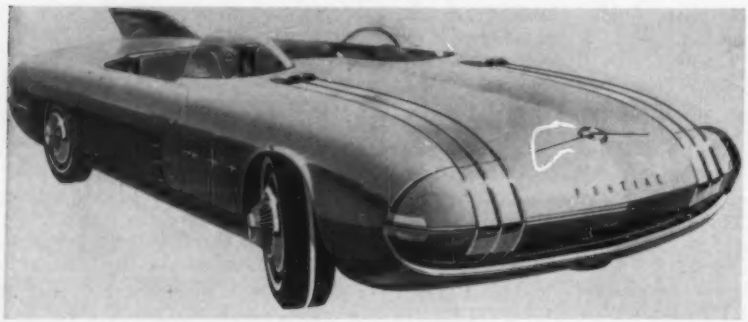
The engine exhaust passes vertically from a port on each side of the car immediately behind the rear window. The exhaust ducts from the front-mounted engine run inside the lateral frame sills.

The Buick Centurion, a two-door four-passenger coupe, is made of fiberglas construction with a chrome sweepspear. The car is 73.5 in. wide, 53.7 in. high, 213.1 in. long, and has a wheel base of 118 in. The tread is 60 in. both front and rear. A 325-hp V8 engine powers the car. The taillights, stop, and backup lights of the Centurion are located in a bomb in the rear center of the car. The front and rear bumpers are an integral part of the shell design. A unique steering-column arrangement features a cantilever suspended steering wheel of the aircraft type.

General Motors Motorama

. . . features experimental automobiles

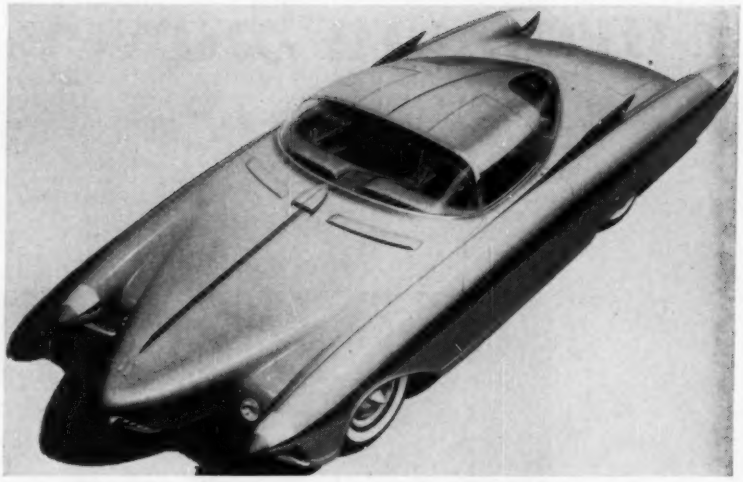
Cadillac's 1956 Eldorado Brougham experimental dream car is a combination of futuristic design with the outstanding characteristics of the classic town car. The car is 78.8 in. wide, 55.8 in. high, 219.9 in. long, and has a wheel base of 129.5 in. The tread is 61 in. both front and rear. The car's horsepower is yet to be announced. When the car's automatic transmission lever is in the drive position the doors are electrically locked and cannot be opened from the outside.

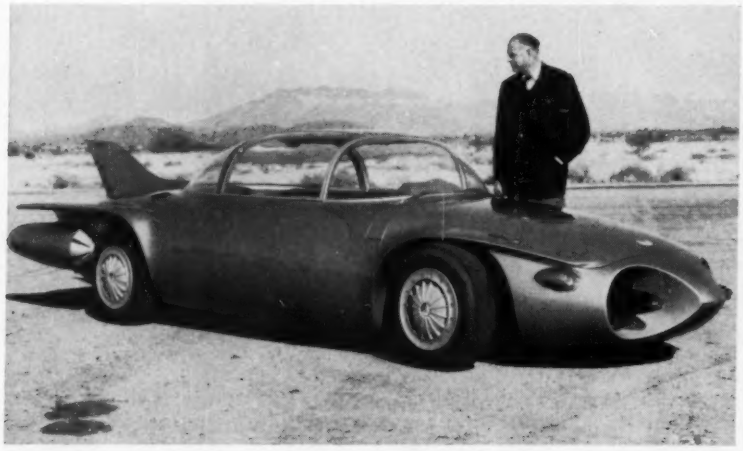


The Club de Mer, a low two-passenger sports car with an annodized brushed aluminum body, is Pontiac's experimental dream car of 1956. Equipped with a 300-hp Pontiac Strato-Streak V8 engine, the Club de Mer stands only 38.4 in. to the top of the windshield and is 180.06 in. long. Built on a 104-in. wheel base, the car is 69.7 in. wide and has a tread of 56 in. front and 54 in. rear. Road clearance is 5 in. Most striking feature of the Club de Mer is the dorsal fin which flashes up from the rear-deck surface. The fin functions as a stabilizing influence during operation.

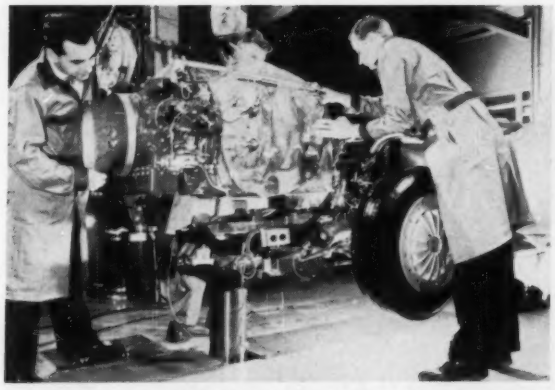
Chevrolet's 1956 experimental car, the Impala, a two-door, five-passenger sport sedan, is powered by a 225-hp Super Turbo-Fire V8 engine. The Impala is 74.4 in. wide, 53.7 in. high, 202 in. long, and has a wheel base of 116.5 in. The tread is 58 in. front and 58.8 in. rear and the car has a road clearance of 6 in. It is equipped with a Power-Glide transmission. Instrument controls fit flush with the surface of the bar, leaving no projections.

Oldsmobile's 1956 experimental car is the Golden Rocket. This two-door sports coupe has a fiberglas body and aerodynamic styling. Only 49.5 in. in height, the Golden Rocket is 75.4 in. wide, 201.1 in. long, and has a 105-in. wheel base. Tread is 59 in. front, 56 in. rear, and the road clearance is 6.5 in. A 275-hp Rocket engine powers the car. To afford easy access to the two bucket seats, a unique automatic seat control is featured in the Golden Rocket. Cowl air inlets just below the windshield on either side of the hood bring fresh air into the passenger compartment. Air-exhaust openings behind and below the backlight rid the passenger compartment of air to allow for passenger comfort. A special steering wheel designed for safety and easy access to the driver's seat is another feature of the Golden Rocket.

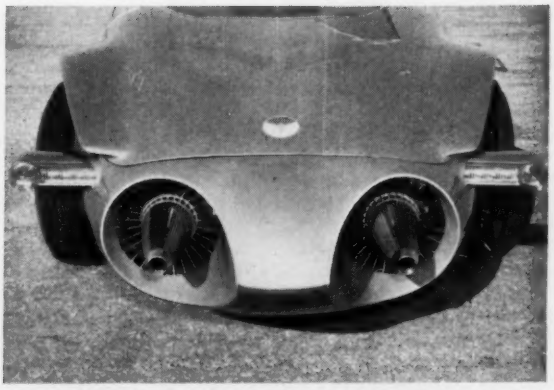




General Motors' experimental gas-turbine passenger car, the Firebird II, is shown with its designer, Harley J. Earl, General Motors vice-president in charge of styling staff. The gas-turbine engine features a heat regenerator which recaptures more than 80 per cent of the exhaust heat and uses it again to heat incoming air. Through the use of the regenerator, the gas-turbine engine gives promise of being able to operate as economically as present-day piston engines.



General Motors' Firebird II goes through final assembly. Research technicians at GM's nearly completed Technical Center, one of the world's great industrial research centers, lower the engine into the chassis of the Firebird II, first experimental gas-turbine passenger car specifically designed for highway use.



The electronic pickup coils of the Firebird II are located in the two cone-shaped bombs located on either side of the nose. The coils pick up the electrical impulses from the Safety Autoway and through sensitive balance between the two coils, the car would be kept continuously "on course" on an electronic highway.

European Survey

Engineering Progress in the British Isles and Western Europe

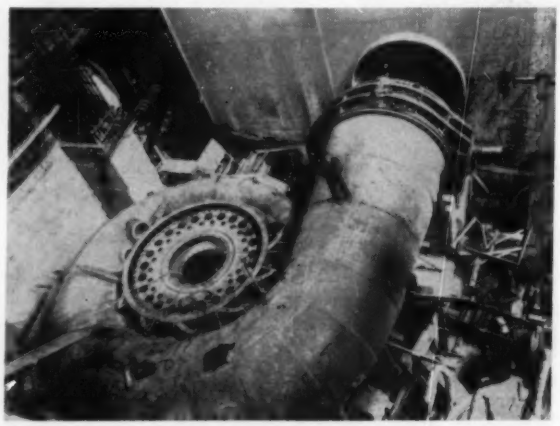
J. Foster Petree,[1] Mem. ASME, *European Correspondent*

General view of Los Peares Dam and Power Station completed at Galicia, Spain

Los Peares Hydroelectric Station

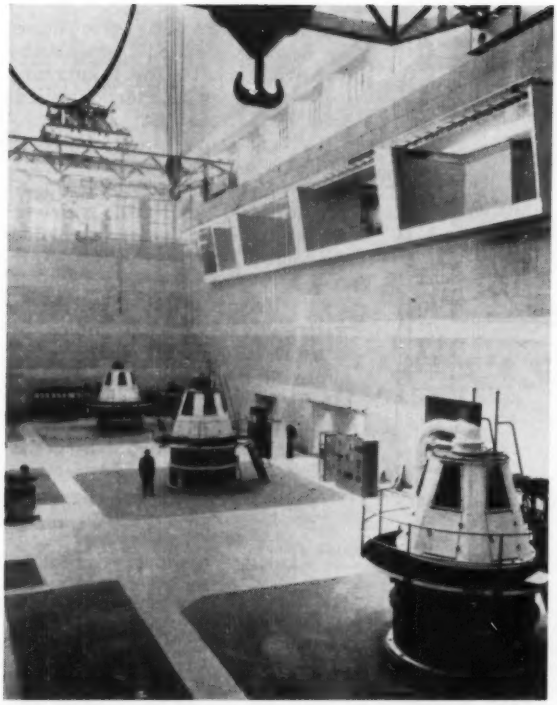
In no single branch of European engineering has there been more sustained activity during the past ten years than in the construction of hydroelectric power stations. Naturally, this development has been most marked in countries which already possessed considerable power-using industries, such as Sweden, France, and northern Italy, but latterly the same trend has been noticeable in some of the less industrialized countries, where hitherto the natural resources had been less fully exploited. Extensive schemes for the utilization of water power are in hand or projected in Portugal, and the same applies to Spain, where the Los Peares station, recently completed in Galicia, should provide a marked stimulus to the expansion of Spanish manufacturing industry. The station has been constructed to the order of the organization known as FENOSA (Fuerzas Eléctricas del Noroeste S. A.) which was formed some 12 years ago to exploit the water power of Galicia, the northwestern district which is bounded on the south by the frontier with Portugal, and which contains the ports of Ferrol and Vigo. FENOSA already operated four power stations of moderate size, these being Las Conchas (31,000 kva), Tambre (22,500 kva), Puentes de Garcia Rodriguez (a steam plant of 40,000 kva) and Compostilla, also a steam plant, now containing two 25,000-kw sets but designed to have double this capacity. None of these compares, however, with Los Peares, which has three alternators, each of 62,500 kva.

The water supply for the station is obtained from the river Miño, where a gravity dam has been constructed, rising 295 ft above the river bed and having a curvature on the front face of about 1000 ft radius. At this point the river gorge is very narrow, so that, though the spill-



Assembling spiral casing of Boving Turbine (72,800 hp) for Los Peares power plant

[1] Correspondence with Mr. Petree should be addressed to 36 Mayfield Road, Sutton, Surrey, England.



Interior view of power house, Los Peares, Galicia, Spain

way over the top of the dam is 225 ft wide, the stilling basin into which the water is discharged is only 150 ft wide. The power station is built close to the dam and is partly within the hillside. The draft tubes of the three turbines are led into an equalizing chamber, whence the water passes into the discharge tunnel which returns it to the river below the spillway. The 900,000 tons of concrete in the dam were made from local granite, crushed in a plant constructed near the site and having a capacity of 45,000 cu ft of granite per day. A cement plant with an output of 200 tons per day was also built, and a concrete-mixing plant with an output of 2000 tons per day.

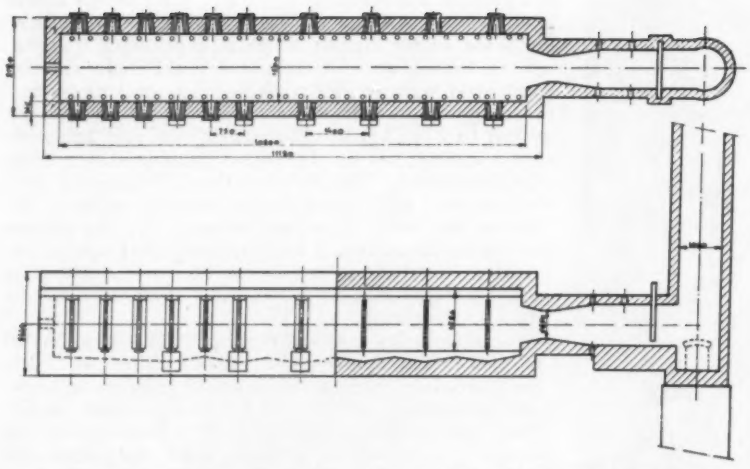
The three Francis turbines run at a speed of 214 rpm. The main contractors were the British Thomson-Houston Company, Rugby, England, who constructed the alternators and the whole of the electrical equipment, Boving and Company, London, being subcontractors for the turbines, which develop 72,800 hp each at the maximum head of 305 ft. They were designed to give their maximum efficiency at 262 ft head, the limiting factor being the reduced flow of water during the summer months. Each turbine is supplied through a separate penstock, the flow being controlled by a butterfly valve, 13 ft bore, at each inlet. The spiral casings of the turbines are of steel plate, fabricated in sections in England and welded together on site. The stay ring, through which the water passes from the spiral casing into the turbine, is also welded and consists of two steel rings with vertical steel vanes between them; it is 18 ft in diam and weighs 22 tons. The flow through the runner is controlled by cast-steel guide vanes, fitted with rubber sealing strips to maintain watertightness when the turbine is shut down. The runners are of cast steel and have an inlet diam of 8 ft 6 in.; they weigh about 13 tons each. There are 18 blades in each runner, machined to the correct shape in a profiling machine and welded in place. After assembly, the blades and the outer band were welded with stainless steel to protect them against cavitation and the blade surfaces were ground to a fine finish. The runner band and hub were then machined and fitted with renewable wearing rings of stainless steel. The power station is so designed that the runner of any turbine can be removed without disturbing the alternator or the turbine shaft; the suction cone under the turbine is made telescopic for ease in dismantling, so that the runner can be lowered and then moved horizontally to a hatchway, where it can be lifted by the crane.

The alternators are each rated at 62,400 kva, 53,000 kw, and generate three-phase 50-cycle current at 11 kv. The air-cooling system is simple and of generous capacity. Each generator is mounted in a square pit, with an air/water heat exchanger in each corner. Baffles divide the pit into hot and cold-air compartments, and fans on the rotor maintain a circulation through ducts in the alternator core and frame to the hot-air compartments and so to the heat exchangers. From the cold-air compartments the air is returned to the top and bottom of the alternator. Individual coolers can be removed separately from the pit for overhaul, each being provided with isolating valves for this purpose. The weight of the alternator rotor and the turbine runner, together with the hydraulic thrust on the turbine, is carried by a bearing on the top of the unit and amounts to about 400 tons; the bearing is of the tilting-pad type and runs with the pads completely immersed in oil. Oil vapor is prevented from entering the rotor by an air seal on the shaft, air from the cooling system being blown into the seal at a pressure higher than that in the housing.

Flame Radiation From Pulverized Coal

For several years research has been in progress on an experimental plant erected at the Royal Netherlands Steelworks at Ijmuiden, Holland, on flame radiation from burners fired by oils and gases, and now this investigation, carried out by an international committee on which Holland, Britain, France, Sweden, and the United States are represented, is being extended to include the radiation from pulverized-fuel flames. For this purpose a new furnace has been designed and constructed, to withstand a temperature of 1500 C. It is generally similar to the oil-fired furnace previously used, except that it is smaller, measuring 1.5 meters sq in cross section as against 2 meters.

The walls are $1\frac{1}{2}$ bricks thick, comprising an inner wall of high-quality insulating brick with a special coating to resist ash attack, and an outer casing of ordinary insulating brick. The roof and bottom are of the same construction as the walls. The whole furnace is contained in a light steel casing and rests clear of the ground on beams, to enable heat losses through the floor to be measured. One side of the furnace is equipped for the measurement of radiation and the other is designed to allow the insertion of various kinds of probes. The radiation pyrometers are mounted on a beam extending down the length of the furnace wall, so that they can be raised and lowered together into different positions.



Layout of new furnace constructed for flame radiation from pulverized coal

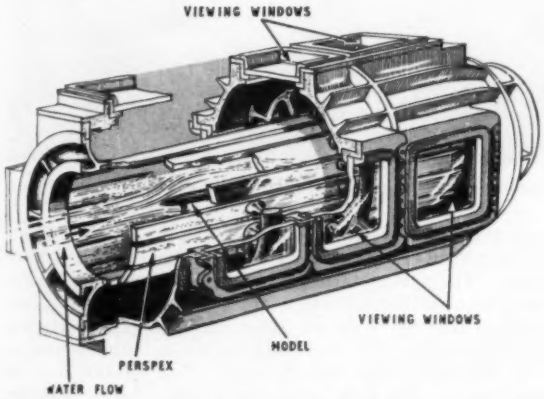
The installation includes an air preheater and a coal-preparation plant, designed to provide dry samples of pulverized fuel of widely varying characteristics. It has a capacity of 500 kg of pulverized coal per hr, with a fineness of 95 per cent through a 200 British Standard sieve. The air preheater is fired with blast-furnace gas and will heat the air to a maximum temperature of 750 C. The equipment includes arrangements for taking high-speed movies of the flames produced in the furnace and it has been found possible by this means to trace the recirculation of the incandescent particles projected outside the flame.

Hydrodynamic Research

The British Admiralty have recently brought into use an extension to their Research Laboratory at Teddington, England. The principal section is a hydrodynamics laboratory containing equipment which, they claim, is unique in the world, including a 60-ton rotating beam surrounded by an annular channel in which to investigate the behavior of bodies moving at high speed under water; two water tunnels analogous in form and purpose to the wind tunnels used in aircraft research; and a glass-sided "water-entry tank" in which will be studied, on a model scale, the behavior of missiles entering the water from the air. The new plant was completed in September, 1954, when a conference on underwater ballistics was held in the Laboratory by the Admiralty and the United States Navy, but it is only recently that the public in general have been allowed to know of it.

The rotating beam has an over-all span of 122 ft and a mean working diameter of 100 ft. Models up to 20 ft long can be tested in the annular channel, which is 34 ft wide and 15 ft deep; normally they are run at a depth of 5 ft below the surface of the water. The maximum speed of the beam is one rotation in about 2 sec, giving the model a speed of approximately 90 knots (150 fps) at a radius of 50 ft, or 100 knots at 55-ft radius. The beam rotates on two of the largest taper roller bearings yet made, these being 6 ft 9 in. diam and spaced 8 ft apart on the kingpost, which is supported on a reinforced concrete slab 16 ft thick. Power to rotate the beam is supplied by a direct-current motor of 1510 hp, taking current at 600 volts and controlled by a Ward-Leonard set of 1750 hp, the alternating-current side of which is a 3-phase synchronous motor run straight off the national grid at 11,000 volts. This whirling arm and tank are housed in a building roofed by a dome about 160 ft in diam. The annular channel holds over a million gallons of water, which is specially filtered to facilitate high-speed underwater photography; objects 100 ft away can be seen clearly in it. There are two large underwater observation chambers through which the models can be observed.

The larger of the two water tunnels has a jet diameter of 30 in. and can test powered models up to 10 in. in diam, with motors of up to 100 hp.



Working section of water tunnel at Admiralty Research Laboratory, Teddington, England

The speed of flow in the working section of the tunnel can be steplessly varied up to 35 knots and the pressure from about 2 lb to 45 psia. The water is circulated by a variable-pitch impeller driven by a d-c motor of 850 hp. The tunnel is novel in having the working section formed of a cage of Perspex bars, enclosing the jet of water within an observation chamber, making it possible to double the effective size of the working section.

Correction

THROUGH an unfortunate error in labeling in New York, the "European Survey" in the January, 1956, issue of MECHANICAL ENGINEERING attributed production of compact steam generators to the Pametrada Research Station. Actually there is no connection or association between Pametrada and John Thompson Water Tube Boilers, Ltd., whose Minipac boiler was described on page 45 of the January "European Survey." Pametrada does not design boilers of any kind.

ASME Technical Digest

Substance in Brief of Papers Presented at ASME Meetings

Steam Power Generation

Maintenance Control in Steam Power Plants, by G. V. Williamson, Fellow ASME, Union Electric Company of Missouri, St. Louis, Mo. 1955 ASME Diamond Jubilee Annual Meeting paper No. 55—A-174 (multilithographed; available to Oct. 1, 1956).

ONE of the ever-important problems in the operation of steam power plants is the establishment, operation, and continuing evaluation of a realistic plant-maintenance program. Such programs are difficult to evaluate because plant variations in operating conditions, equipment, fuel, and many other factors are of such a nature they cannot be even empirically compensated in any study. On the other hand, with improvements in plant heat rates gradually approaching the point of diminishing return, the power-plant designer or operator must look further into the possibilities for improvement in all areas of operating cost. As all power operators know, the maintenance program is at the heart of successful operation. It is a traditional rule of thumb, and current results bear it out, that this program will cost each year roughly 2 per cent of the plant investment. With the large power-building program of the past ten years and the one now in progress, this 2 per cent item is worth more attention. Maintenance control is an area where considerable work remains to be done and at Union Electric it has been placed higher on the priority list.

Simply stated, the author's company approaches this problem from the following aspects: (1) Station design—where a good maintenance arrangement starts through liaison between design and operating groups. (2) Test engineering—with reliance on a continuing test program for support of a maintenance philosophy approaching breakdown maintenance. (3) Cost accounting—with records continually studied by engineer analysts. Highly detailed records are now available for 10 years and provide some standard of performance. (4) Supervisory training—with improved productivity and improved quality as an objective. (5) Operating-maintenance rapport—plant management stresses interdependence. The paper reviewed the various points in each of these categories that might be of help in the ultimate success of any maintenance program.

Dresden Nuclear Power Station—Preliminary Design and Economics, by T. G. LeClair, Commonwealth Edison Company, Chicago, Ill. 1955 ASME Diamond Jubilee Annual Meeting paper No. 55—A-214 (multilithographed; available to Oct. 1, 1956).

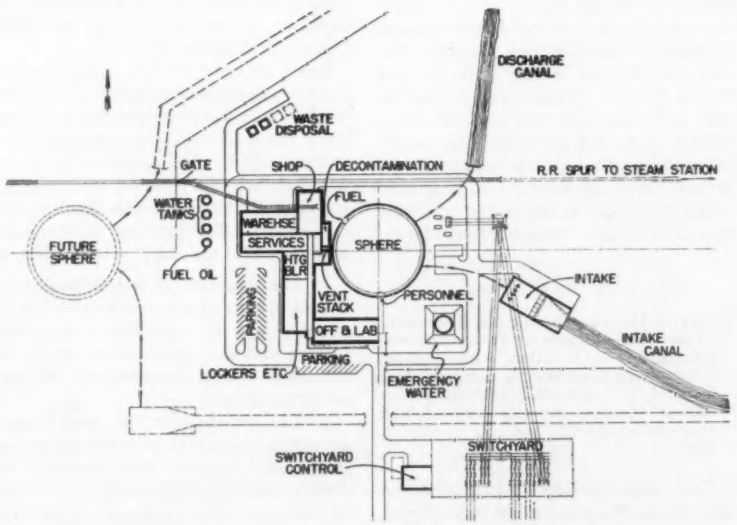
A DISCUSSION of the preliminary design and economics of the 180,000-kw all-nuclear power plant to be constructed near Chicago using the dual-cycle boiling-water reactor is presented in this paper. The study group formed for this project was called Nuclear Power Group and included American Gas and Electric Service Corporation of New York City, Bechtel Corporation of San Francisco, Calif., Commonwealth Edison Company of Chicago, Ill., Pacific Gas and Electric Company of San Francisco, Calif., and Union Electric Company of Missouri.

Since deciding to go forward with this construction project three other utility companies have joined the Nuclear Power Group team. They are Central Illinois Light Company of Peoria, Ill., Illinois Power Co. of Decatur, Ill., and Kansas City Power and Light Company of Kansas City, Mo. The seven utility companies now in the group had a total generating capability at the end of 1954 of 14,500,000 kw. This is approximately $1/7$ of the total generating capacity of the public and privately owned utilities in the United States. These companies operate in 12 of the 48 states.

The factors which influenced the selection of a site of this nuclear-fueled plant are very similar to those of a conventional plant. There are a few exceptions, which were mentioned in the analysis of (1) geography and geology; (2) relation to fuel; (3) relation to cooling water; (4) relation to load.

The General Electric Company has agreed to design and build this nuclear power plant for a price of $45,000,000. In addition, General Electric will make substantial research expenditures not covered by this price. The member companies of the Nuclear Power Group recognized that no one company of the group could underwrite all the costs of this endeavor since the resultant energy cost from this first plant would be about one cent per kwhr.

The present total cost of power generated by modern conventional plants in



Layout on the property of the Dresden Nuclear Power Station and service facilities

the higher-fuel-cost area in which this plant is to be located is about $^3/_4$ of a cent per kwhr. The financing of the plant has been approached from the premise that any one company could only justify a capital investment in the nuclear plant which would result in about this total power cost.

The investment to be capitalized was determined in the following manner:

The estimated fuel, operating, and maintenance cost per kwhr for the nuclear plant was subtracted from the total cost of power from a modern coal-fired plant in the same area.

The result is the allowable fixed charges on the nuclear plant per kwhr. This number, multiplied by the estimated annual output, is the allowable annual fixed charges. The annual total fixed charges divided by the estimated annual percentage required for all fixed charges on this type of plant equals the justifiable capital investment. In this case the justifiable amount is $30,000,000 of the contract price in addition to the cost of land, transmission, interest, and overheads. Commonwealth Edison will capitalize this amount and will own and operate the plant. We must keep in mind that these costs are for a single unit and the first of its kind. Until such a program as Commonwealth Edison has under way is completed there is no possible way to determine accurately the costs for a second or third unit and that answer determines whether or not such units are going to be competitive. The author is confident that they will be.

The remaining $15,000,000 will be contributed by the Nuclear Power Group, Inc., a nonprofit research corporation financed by all of the eight associates of the Nuclear Power Group, including Commonwealth Edison. For this contribution, which is to be paid over a five-year period, the companies will gain technical and research information from the developmental work, experience, and training which can be obtained only by actively participating in the design, construction, and operation of such a full-scale nuclear power plant.

Status of Demineralizing for Treatment of Boiler Feedwater in Today's Power Plants, by V. J. Calise, Mem. ASME, Graver Water Conditioning Company, New York, N. Y. 1955 ASME Diamond Jubilee Annual Meeting paper No. 55—A-199 (multilithographed; available to Oct. 1, 1956).

This paper provides an interim report on some of the present trends, problems, and practices, as well as results obtained from the use of multibed and mixed-bed ion-exchange demineralizers in the production of low-solids boiler feedwater in today's industrial and central-station power plants.

The author referred to and included data on case histories in the literature, mentioned successful results as well as categorized some of the problems and the difficulties, and pointed up the latest developments and trends in design and application that may be of value to the power-plant engineer considering such installations in new power plants. In carrying out this report the author has furnished the industry with an excellent bibliography on the subject of demineralization in the power field.

Design of a Large Coal-Fired Steam Generator for 200 F Exit-Gas Temperature and Operating Experience With Pilot Plant, by W. L. Wingert, Mem. ASME, and R. J. Stanley, The Detroit Edison Company, Detroit, Mich. 1955 ASME Diamond Jubilee Annual Meeting paper No. 55—A-143 (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1956).

The paper states that one of the few remaining sources available for major cycle improvements in a conventional plant cycle is the sensible-heat loss in the steam-generator stack gases. Reduction of this loss in coal-fired steam generators is limited for the most part by the amount of sulphur and moisture in the fuel. Conservative design, in general, has been restricted to a minimum full-load stack-gas temperature ranging from 250 to 300 F depending on the quality of fuel economically available. The restriction stems from such operating problems as corrosion, air-heater fouling, and flue-dust-removal difficulties.

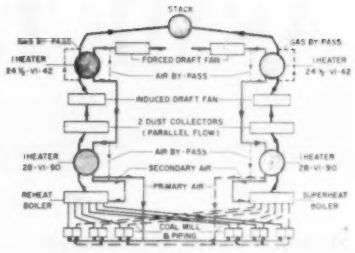
Based on some exploratory investigations it was decided to review the studies of the series air-preheater design using 200 F full-load stack-gas temperature instead of 235 F. The co-operation of the Air Preheater Corporation was enlisted and with their assistance the studies were carried out. Basic design requirements established for the study were as follows:

1 The upstream or hot-air preheater should operate in a temperature range at all times such as to preclude or minimize fouling and this temperature would be conservative from the standpoint of dust-collector design.

2 The downstream or cold heater should be arranged to permit frequent and convenient removal from service for surface washing, this outage in no way to influence steam-generator availability or capacity.

3 Unit operation should be maintained at a reasonable efficiency during cold-heater outage periods.

4 Since an installation of this type would be in the nature of a calculated risk the design should lend itself to easy and low-cost revisions to return the unit to a conventional design and efficiency basis.



Gas-air circuit diagram, River Rouge No. 3 steam generator

Results of these studies showed a boiler-efficiency improvement of upward of $1^1/_2$ per cent. Considering all investments and costs for equipment, additional power, etc., the efficiency saving represented a good return on the increased first cost. Considerations other than cost which appeared favorable were (*a*) such an installation would certainly be a progressive step in improving boiler-plant economy for this and future plants; (*b*) it was believed that continuity of service for a steam generator would be improved by the fact that the hot heater would be operating at a temperature conducive to trouble-free operation and the cold heater could be removed from service without affecting the unit availability and capability, and (*c*) the dust collector would operate at a temperature which would minimize corrosion and dust-removal problems. These factors led to a decision to proceed with the design and installation of the series air-heater arrangement for unit 3 at the River Rouge Plant.

Since relatively little performance data on low gas-temperature operation with coal firing was available it was believed a pilot test plant could give valuable information and load to design features resulting in improved operation of the main unit. To this end The Air Preheater Corporation and The Detroit Edison Company collaborated in the installation and operation of such a test plant at the Conners Creek Plant in Detroit. The test unit, an actual Size 7 air preheater, was put in service in late February, 1955. The authors hoped that information gained will lead to the optimum heater design such as basket construction, location of basket removal doors, materials, etc., and will establish optimum operat-

ing methods, i.e., type, medium and pressure for soot blowing, service washing procedures and frequency, corrosion-protection requirements, etc. Preliminary results of this test were discussed.

Test of a Once-Through Steam Generator With a Liquid Metal as a Heat Source, by J. J. Morabito and R. H. Shannon, Mem. ASME, Atomic Power Development Associates, Inc., Detroit, Mich. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-189** (multilithographed; available to Oct. 1, 1956).

THE basic concepts and factors involved in the design and testing of a once-through steam generator using liquid metal as a heat source are covered in this paper. The purpose of the test was to prove the unit's feasibility.

Most of the nuclear reactors in operation and those currently proposed are of the liquid-cooled type. The once-through type of steam generator in the authors' opinion is particularly adaptable in the generation of steam utilizing heat energy from a nuclear reactor with a liquid coolant because a simple counterflow shell-and-tube heat-exchanger design can be used; inherent compactness can result in considerably lower installed cost than for other types of units.

Atomic Power Development Associates, Inc., is currently engaged in the design of a nuclear power plant utilizing a fast-breeder-type reactor. The primary coolant, sodium (Na), removes heat energy from the reactor and transfers the heat energy to the secondary coolant, a sodium-potassium alloy (NaK). Heat energy in the NaK is then transferred to water and steam in the steam-generator units for use in the power-generation cycle. These are three primary coolant loops and associated auxiliaries, three intermediate heat exchangers, three secondary coolant loops and associated equipment, and three steam-generator units.

The reasons for using two liquid-metal systems with intermediate heat exchangers are (1) to avoid the hazard of a chemical reaction between water and radioactive sodium; (2) to eliminate the possibility of the steam and water becoming radioactive; thus limiting the radioactivity to those components and systems in the reactor building. Radioactivity in the NaK coolant system is maintained below biological tolerance level by means of adequate shielding of the NaK equipment in the reactor building; (3) to insure against moderating materials being admitted into the reactor. Even though there is a possibility of a chemical reaction between water and NaK in the steam-generator units, the chemical reaction will not result in a rupture of the primary coolant system or violate the premise of radioactivity containment.

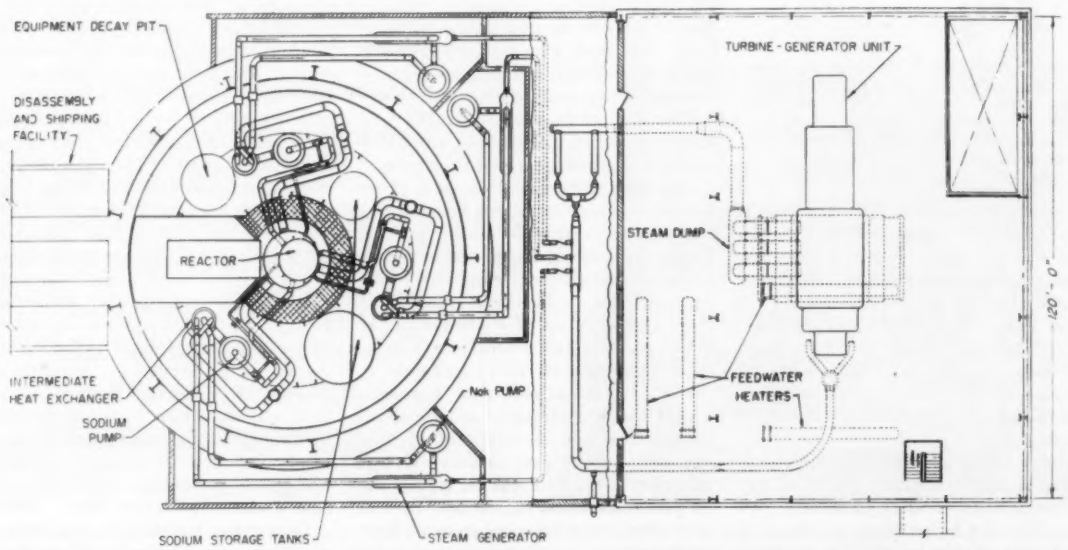
The once-through-type steam-generator unit which will be used in the fast-breeder-type reactor plant is a simple shell-and-tube counterflow heat exchanger. Since the water and steam are at a higher pressure than the NaK (1200 psig as compared to 50 psig), it was decided to have the steam and water inside the tubes. The shell of the unit can then be designed for the lower NaK pressure resulting in a thinner shell and lower cost. Placing the water and steam inside the tubes also permits the use of slightly thinner tubes and this, combined with the better film coefficient of water and steam inside the tubes, produces a higher overall transfer coefficient and resulting lower total heat-transfer surface-area requirement.

U-shaped construction is used to eliminate the need for providing an expansion joint on the shell side which would be a potential weak point in the unit. Thermal-barrier tube sheets are provided at both the hot-and-cold-end tube sheets to minimize the effects of thermal shock on the tube sheets.

The authors then gave considerable data on the nature of tests they plan to run and the objectives they hope to achieve. Considerable information was advanced in design considerations.

Plant Management and Other Factors Affecting Maintenance Costs in Steam Generating Stations, by V. F. Estcourt, Fellow ASME, Pacific Gas and Electric Company, San Francisco, Calif. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-87** (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1956).

THE obvious advantage of higher thermal efficiencies were covered in an earlier paper where the author established fuel costs as representing 35 per cent of the total production cost and maintenance



Plan view of APDA proposed nuclear power plant utilizing a fast-breeder-type reactor. Primary coolant is sodium.

and operating charges amounting to about 10 per cent. In this paper the subject discussed is maintenance.

Although direct maintenance costs in thermal power stations comprise only a small percentage of the total cost of production, replacement power costs while a generating unit is out of service for maintenance, to Mr. Estcourt's thinking, is also chargeable to the over-all cost of the job. This may amount to considerably more than the entire cost of the repairs. The control of maintenance cost is concerned principally with those factors which influence the ability of the plant to stay on the line, and this includes a wide variety of problems relating to equipment design, plant layout, types of fuels, manpower utilization, and other management problems.

The limited statistical value of the term "operating availability" was discussed, and the concept of "relative mechanical availability" was introduced. Increasing technical and physical complications, together with larger unit sizes and greatly expanded generating systems, suggest the need for a redistribution of responsibilities at the plant level. This has created a demand for higher-grade engineering graduates with academic qualifications more suited to the special problems of thermal-power production, and a larger degree of cooperative effort between the utilities and the universities also appears desirable.

Two highly interesting appendixes, one on equipment design factors and the second on a method of computing manhours for different work schedules was included.

Fly-Ash Refiring, by F. G. Feeley, Jr., Mem. ASME, Carbide and Carbon Chemicals Company, New York, N. Y. 1955 ASME Diamond Jubilee Annual Meeting paper No. 55—A-182 (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1956).

An attempt to solve the fly-ash disposal problem is presented in this paper. Cooling water and raw materials usually predominate in site selections. Even though fly-ash disposal might be a factor in the selection of a modern plant site, it certainly could not have been envisioned 30 years ago when some of the now vast plants of Carbide and Carbon Chemicals Company had their beginnings.

The latter situation held certainly true of the author's company plant on the Kanawha River at South Charleston, W. Va. The first boiler plant consisted of six 20,000 lb per hr Sterling boilers—stoker-fired. Three boiler plants presently serve the plant, with a capacity many times the original 120,000 lb per hr. During years of expansion, fly ash has been pumped to first one low-lying area after another until the adjacent topography no longer provides a natural source of disposal. Fly-ash-disposal costs have mounted to figures exceeding $1.75 per ton. Future disposal costs will rise even more sharply because of the need of pumping fly ash over adjacent ranges of hills into new low-lying ground.

When the latest power-plant expansion came along it was decided to investigate a separate device to burn carbon out of and melt the fly ash from the new as well as existing boilers. Bearing in mind that the fuels native to the area average less than 10 per cent ash and that coals are being burned elsewhere in the country with ash contents approaching 40 per cent, it was reasoned that a properly designed boiler should be able to refire ash up to a point where the total inert dust loading in the furnace approached that which would prevail with a coal of 40 per cent initial ash content.

Drawing in every way possible upon the experience of other plants, a slagging bottom boiler was developed that was unconventional in that the hearth is of purely refractory construction and completely separate from the structural and pressure parts of the boiler. The boiler is fired by downwardly inclined adjustable burners—three in the front wall, three in the rear wall, and staggered—to promote maximum turbulence with the higher-temperature zone in the center of the hearth in a line parallel to the boiler drums. The slag-tap opening is in the near side of the hearth. Dust is collected from a gravity hopper below the last boiler pass, from a mechanical separator after the air heater, and from a vertically oriented electrostatic precipitator following the induced-draft fan. A total of 11 reinjection feeds, utilizing hot air from a separate single-stage blower for motive source, pick up the dust from the hoppers and refire to nozzles located between and below the rear-wall coal burners. Pocket-type motor-driven dust feeders are located on all connections of the two dust collectors. The boiler shown is rated at 289,000 lb of steam per hr, at 615 psig pressure, 670 F total temperature, when supplied with boiler feedwater at 388 F. Design furnace heat release is 15,800 Btu per cu ft per hr and the entire furnace envelope is composed of $3^1/_2$-in. tubes on $3^3/_8$-in. centers. Design efficiency of the unit was set at 87.0 but its performance has consistently been at 88.6 when operating at design steam flow. Attention was called to the fact that this boiler was built initially without soot blowers and without any future provision therefor. A single long retractable deslagger was installed ahead of the slag screen but this blower has never been used and has now been removed to storage.

The results achieved with this method of firing and refiring have exceeded all expectations. Total stack discharge at 300,000 lb per hr steam flow is less than 0.5 lb per 1000 lb of flue gas. All ash is recovered as a slag which is readily disposable, and sometimes salable, product. The boiler is tapped once a day requiring approximately seven man-hours of labor. The slag has been used for roads, driveways, and parking lots and is under investigation as a raw material for the fabrication of building blocks, bricks, and so on.

The Work of the Central Electricity Authority (Britain) on the Fouling and Corrosion of Boiler Plant, by H. E. Crossley, Central Electricity Authority, London, England. 1955 Diamond Jubilee Annual Meeting paper No. 55—A-153 (multilithographed; available to Oct. 1, 1956).

Covering a period of seven years, this paper deals with problems concerning the external fouling and wastage of heating surfaces in a boiler plant.

The introduction explained the organization of researches of this kind within the Authority and pointed out that the subject treated in this paper is mainly concerned with full-scale trials on boiler plant. The author then summarized the results of inquiries to learn the extent of boiler-fouling troubles and air-heater corrosion in British power stations. It was felt that a considerable improvement had been attained during the period surveyed. The correlation of boiler fouling with constituents of coals burned, particularly the rate of fouling of superheaters as related to the chlorine content of coal, was then taken up. These tests led to a method of alleviating fouling by blending coals as described in the paper. This was continued with a brief account of other methods of alleviating trouble, such as the removal of chlorides from coals; attempts to remove sulphur compounds from coals; the humidification of combustion air; the recirculation of flue gas; the use of acid-resistance metals in air heaters; the use of coke breeze; the raising of minimum metal temperatures in air heaters; the reduction of superheater metal temperatures; modifications of the combustion of oil, and of the combustion of pulverized fuel.

Future investigations for which preparations are now being made were mentioned. The most important of these

were thought to be an investigation of the many effects of recirculating flue gas with pulverized-coal combustion, and a fundamental study of metal and gas temperatures and gas composition associated with varying combustion conditions. The paper concluded with a brief discussion in which it is considered that the stage already has been reached where methods of alleviating present-day fouling and corrosion trouble are known. Present trends, therefore, are to assess the relative costs of different methods of alleviation; to attempt to forecast problems of the future, and to work out economic methods by which these problems can be overcome.

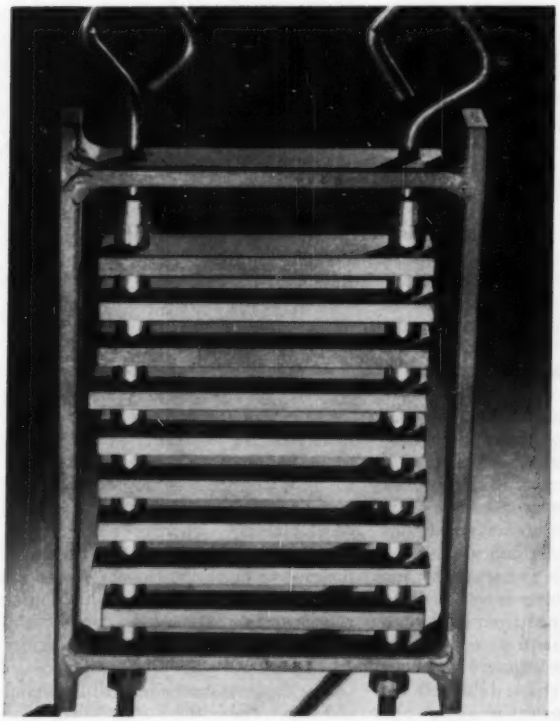
High-Temperature Corrosion of Alloys Exposed in the Superheater of an Oil-Fired Boiler, by D. W. McDowell, Jr., The International Nickel Company, Inc., New York, N. Y., R. J. Raudebaugh, International Nickel Company, Inc., Bayonne, N. J., and W. E. Somers, Assoc. Mem. ASME, Public Service Electric & Gas Company, Newark, N. J. 1955 Diamond Jubilee Annual Meeting paper No. **55—A-203** (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1956).

A PROGRAM to assist in the determination of which heat-resistant alloys perform most satisfactorily in various high-temperature corrosive environments has been conducted for the past several years by the Stainless Steel and Heat Resistant Alloys Section of the Development and Research Division, International Nickel Company, Inc. This information has been accumulated by the installation of heat-resistant test racks containing a wide variety of test specimens in actual industrial environments where information is desired and needed. By testing materials in the actual service environment, much more realistic information is obtained than by conducting similar tests in the laboratory. After a suitable exposure time, the racks are removed from the high-temperature environment and each test specimen is sectioned and examined under the microscope to determine the type and extent of attack. For comparative purposes, these results are extrapolated to inches penetration of attack per year for each alloy. Results of such tests materially aid in the selection of materials which are most suitable for a given industrial high-temperature environment.

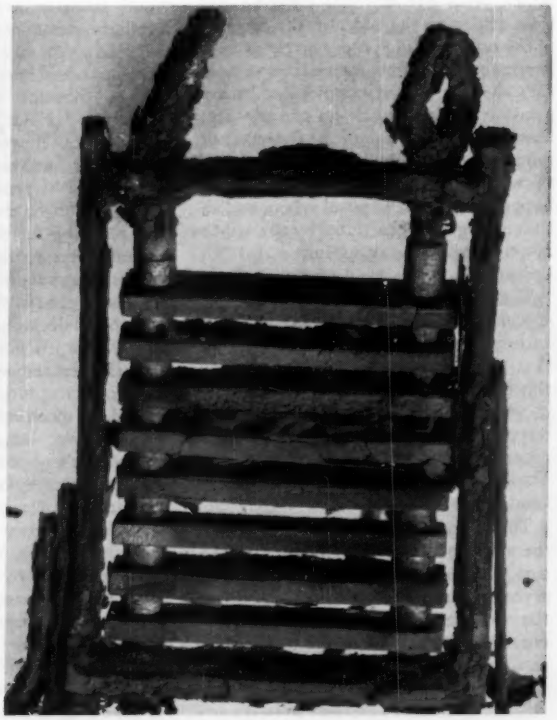
In co-operation with the Public Service Electric and Gas Company, Newark, N. J., a high-temperature alloy investigation was instigated by exposing a series of test racks in the superheater of an oil-fired boiler using Bunker "C" fuel oil. The presence of large percentages of sulphur, vanadium, sodium, and calcium in this Bunker "C" oil led to the belief that such an environment would show high deterioration rates for all alloys that were exposed.

This assumption proved to be true. Nevertheless, the authors' companies felt it important, from the economics point of view, to have a basis for judgment as to how much longer certain alloys would last than others. In other words, the investigation would ascertain whether the exploitation of certain of the studied alloys, in preference to the others, would be justified on the basis of economic considerations and their length of service.

The boiler selected for the installation of the three racks is a Babcock & Wilcox radiant-type boiler, designed for a full-load steam output of 550,000 lb per hr at 1350 psi, and 950 F at the superheater outlet with either pulverized coal or oil firing. This boiler, No. 52, Marion Generating Station, Jersey City, N. J., went into service in 1941 and had been



Test Rack No. 50 before 648-hr exposure in the superheater section of the oil-fired boiler at Public Service Electric and Gas Company, Marion Generating Station, Jersey City, N. J.



Test Rack No. 50 after 648-hr exposure in superheater section of oil-fired boiler at Public Service Electric and Gas Company, Marion Generating Station, Jersey City, N. J.

fired with Bunker "C" oil since April, 1952.

All three test racks were supported from a hook clamped to one of the first row tubes of the second bank of the high-temperature superheater about 3 ft from boiler side wall in such a manner that they hung clear of the superheater tubes in the cavity on the furnace side of the bank. Because of this method of support, the specimens may be said to have been at the gas temperature.

Wrought alloys, cast alloys, and cast alloys with various coatings were tested. Before installation into the test rack all specimens were carefully gaged for thickness with micrometers. After exposure, prepared sections were measured under a micrometer microscope in order to record the thickness of uneffected metal remaining and structural discontinuities in the scale.

The maximum deterioration rates of all of the test specimens were expressed in inches penetration at the surface for the duration of exposure and by linear extrapolation for a year's interval. This extrapolated value makes it possible to compare the corrosion rates. These results were given in tabular form. The data from this table were arranged in order of the severity of the parent-metal attack with the material suffering the least attack at the top and the severity of corrosion getting progressively greater down the list. It is interesting to note that the four coated samples had rather a fast corrosion attack on the coating; however, the duration of the test was not long enough to allow complete penetration of the coating. What would happen to the parent metal when, and if, the coating were penetrated by the attack of the corrosive atmosphere is not known.

The reason for putting these coated specimens at the top of the list, the authors explained, was merely to show that there was no base-metal attack in this case. It should be pointed out that it was not considered practical to extrapolate the corrosion rates to inches penetration per year for coated specimens. These coated specimens were discussed in greater detail later.

The test rack was positioned vertically, the samples being in a horizontal position, one above the other. The data given in the tables showed a number of the specimens were thinned more along one edge than the other, with maximum attack occurring along the leading edge relative to gas flow. In those cases where a consistent difference in the degree of attack was observed along opposite edges, two penetration rates were given.

A Planned Turbine Testing Program, by F. H. Light, Mem. ASME, Philadelphia Electric Company, Philadelphia, Pa. 1955 ASME Diamond Jubilee Annual Meeting paper No. 55—A-53 (mimeographed; available to October 1, 1956).

ACCORDING to this paper a planned steam-turbine testing program is the most effective means of detecting reduced machine performance, since it provides data exposing the reasons for the loss in economy.

Such a program, consisting of periodic monthly efficiency tests, can produce operating savings by (1) providing current data to adjust costs for turbine loading and interconnection energy transfers, (2) indicating a build-up of turbine deposits where turbine washing is justified, and (3) exposing other causes of turbine inefficiency so that proper maintenance can be planned ahead of outage for overhaul. A well-planned program that provides proper turbine instrumentation located conveniently so that a few observers can perform the periodic turbine tests will require only a few man-hours per month to obtain and compute the test results. This expenditure for instruments and time is well justified, on the basis of experience, by the operating savings effected.

The basic cycle for turbine testing should be simplified as far as possible. Auxiliary steam use, boiler blowdown, soot blowing, and condenser hot-well make-up should be eliminated, if possible, for the duration of the test period. Flows into, or out of, the cycle must be measured by flowmeters or volumetric means, and suitable valving with telltales should be provided to permit positive isolation of the cycle.

In planning for the long-range testing program the relative accuracy of test measurements and their effect on the final test result always should be the guiding principle in deciding on the instrument to use. By experience, flow measurements have the greatest inherent inaccuracy so it follows the most care should be expended on measurement of the principal turbine flows. Measurement of temperature using thermocouples is probably next in importance. Pressure measurements and electrical measurements can be made with a high degree of accuracy and, as a result, present the least difficulty.

The necessary instrumentation and expenditure of manpower is well justified by the results obtained from a planned testing program. Generation costs for plant loading can be adjusted to reflect current performance and test data can aid in planning maintenance work by pinpointing the cause of loss of turbine efficiency. Station instruments properly calibrated and maintained can give consistent and accurate test results without resort to an elaborate arrangement of special test instruments.

Turbine Supervisory Instruments, by J. C. Spahr, Mem. ASME, and R. L. Richards, Westinghouse Electric Corporation, Philadelphia, Pa. 1955 ASME Diamond Jubilee Annual Meeting paper No. 55—A-62 (multilithographed; available to Oct. 1, 1956).

THE operation and function of a series of current turbine supervisory instruments were described in this paper. The instruments are shaft-eccentricity meter, cylinder-expansion meter, differential-expansion meter, flange differential-temperature meter, shaft-position meter with a hydraulic back-up device, thrust meter, and shaft-vibration meter.

These supervisory instruments are used to supplement the operator. All of them can be equipped with an alarm circuit having limit contacts. These are set for values beyond which continued operation is considered unsafe. Thus, if any of the foregoing measured functions exceed safe limits, an alarm is sounded to warn the operator of the existing condition. It is the duty of the operator to investigate the condition and determine what action should be taken. Used in this manner, the supervisory instruments serve as a backup and guide to the operator. The decisions of operation are left to the operator.

Recently the philosophy has been advanced that the supervisory instruments should be the primary source of turbine-operation decisions; that they be used in the actual operation of the turbine rather than to just give the warning signal. The instruments would be equipped with automatic devices to trip the turbine off the line in the event the measured function exceeded safe limits.

The reasoning responsible for this trend is that the supervisory instruments are in a better position to "observe" the conditions of the unit, and that the instruments are in reality recording the results of internal disturbances within the unit. The operator must depend on the instruments to warn him of abnormal developments; therefore the instruments could easily complete the entire function of operating the unit. Such an approach to instrumentation means that the present supervisory instruments must be converted to mechanical operators. It is expected that the trend toward operation by instruments will be a gradual one. The authors stated that Westinghouse has started in the direction that the supervisory instruments will be arranged to trip the units off the line in

the event the instruments indicate a condition of distress.

Maintenance Factors Affecting Production Costs, by W. F. Oberhuber, Mem. ASME, and C. W. Watson, Mem. ASME, Philadelphia Electric Company, Philadelphia, Pa. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-128** (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1956).

BEGINNING by considering total production costs and after removing the cost of fuel from the total production cost, it was found that the remainder included the costs of supervision and engineering, plant-operating labor, supplies and expense, and maintenance. In large predominately steam systems, maintenance represents approximately 50 per cent of these costs. The maintenance portion of production costs is the relatively unexplored field wherein lies the greatest opportunity for potential reduction of total production costs.

When purchasing a new unit engineers have been able to justify additional capital expenditures for such automatic equipment through economic studies which accurately evaluate the resultant operating labor savings. At present, when a company looks over a proposed design it may recognize certain features that, if retained, might result in excessive maintenance. If detailed maintenance costs could be predicted accurately, they would be weighed against capital costs when purchasing new equipment, thereby obtaining optimum selection of equipment from a total-cost viewpoint. It is questionable whether we know the parameters necessary to evaluate certain maintenance costs. It appears that a great deal of further study and discussion is necessary to get the greatest use of the mass of maintenance-costs data all operating utilities possess.

In striving toward this end, it is necessary to analyze the factors that constitute maintenance costs. As the authors see the picture now, it appears that the major factors affecting these costs are: Original design, management policy, planning, organization, and cost-accounting system. Each of these points were discussed.

Fluid Flow Through Two Orifices in Series III—The Parameters of Metastable and Stable Flow of Hot Water, by W. J. Kinderman, Mem. ASME, and E. W. Wales, Assoc. Mem. ASME, Yarnall-Waring Company, Philadelphia, Pa. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-192** (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1956).

THIS paper presents a discussion of the flow of hot water, with saturation pressure above the downstream pressure, through orifices or nozzles depending largely upon the nature of the expansion of the fluid and the confinement of the expansion by the orifice or nozzle. Intermolecular forces as influenced by surface tension tend to metastabilize the initial liquid phase to a corresponding subsaturated pressure. These forces also tend to metastabilize the droplets formed in steam at the critical size corresponding to the critical pressure at expansion.

The influence of orifice or nozzle form on the expansion process for initially stable and metastable entering fluid is analyzed with confirming test data interpreted from the intermediate-pressure measurements between two identical orifices in series.

Control effects obtainable with change of the intermediate pressure between two orifices as determined by the thermal state of the fluid are briefly discussed and a new practical application form of such a control element as applied to condensate removal from steam systems is described. Attention is directed toward new avenues for further investigation in this field.

Boiler Feedwater Studies

Metal Transport in Liquid-Water Systems and Effect on Heat Transfer, by S. C. Datsko, The Babcock & Wilcox Company, Alliance, Ohio. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-183** (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1956).

PRESENTED here are the experiences of a series of tests that were conducted to determine the effects on heat transfer caused by the corrosion by water of zirconium tubes and by the deposition of corrosion products of a stainless-steel system on the zirconium-tube walls. These tests were conducted at water velocities from 2 to 30 fps and heat-flow rates from 30,000 to 500,000 Btu per sq ft of surface in single-tube countercurrent water-to-water heat exchangers. The heating-water temperature ranged between 500 and 620 F and the cooling-water temperature between 450 and 500 F. Several water treatments, such as deionization and oxygen or hydrogen additions, were investigated.

Results of these tests showed that: (*a*) Corrosion of zirconium at these temperatures was not sufficient to cause measurable increases in heat-transfer resistance; (*b*) with oxygen concentrations up to 2 cc per liter of water, no measurable deposition occurred on the tubes at any of the combinations of low-water velocities and low heat fluxes or high-water velocities and high-heat fluxes, even though no removal of corrosion products was attempted; (*c*) at oxygen levels between 100 and 1000 cc per liter, sufficient deposition of stainless-steel corrosion products occurred on the cooled side of the zirconium tube to decrease heat-transfer coefficients approximately 50 per cent; such deposits could be prevented or removed by continuous operation of an ion exchanger; (*d*) there were indications that either hydrogen additions or cold-water washing would also remove the deposits; (*e*) deposition appeared to occur only on regions of high heat-transfer rates and was associated with pH between 5 and 7.

Fuels Technology

Bonded Fireside Deposits in Coal-Fired Boilers—A Progress Report on the Manner of Formation, by Charles H. Anderson and Erle K. Diehl, The Babcock & Wilcox Company, Research Center, Alliance, Ohio. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-200** (multilithographed; available to Oct. 1, 1956).

A DISCUSSION of the composition and formation of ash deposits on convection surfaces of coal-fired steam boilers is presented in this paper. The innermost layer of these deposits, as others have reported, seems to have different chemical and physical characteristics than the bulk of the deposit, and to the authors it was apparent that this layer was an important factor in bonding the deposit to the tubes.

The chemistry of the compounds which make up the inner layer were investigated and the role which this layer plays in the formation of the over-all deposit was described. Sulphated iron and aluminum in the form of complex alkali sulphates were held responsible for the low-melting characteristics which cause the formation of the tightly bonded inner layer. These compounds were then synthesized in the laboratory from fly-ash constituents and a synthetic flue gas.

Tests using an air-cooled probe inserted into an operating boiler showed that the inner layer of deposit resulted from a slow reaction between sulphur gases and the initial dry dust on the tube. After a period of time this layer attained sufficient thickness to provide a foundation upon which the outer bulk of the deposit would build up.

Except for a widely varying sulphur content, the outer deposit, the authors

stated, resembled fly ash in its chemical composition. It increased in size and strength through a sintering action, with the alkali sulphates and silicates apparently the principal bonding agents.

Upgrading Burner Performance of Distillate Fuel Oils by Hydrogen Treatment, by R. P. Gilmartin, Mem. ASME, Gulf Oil Corporation, Pittsburgh, Pa., W. A. Horne, and B. R. Walsh, Mem. ASME, Gulf Research & Development, Harmarville, Pa. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-210** (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1956).

In this paper the authors claimed that the recent advent of catalytic re-forming of crude oils to produce gasoline permits, for the first time, a means of upgrading the distillate fuel oils as well as the gasoline. In these latest methods a reaction process between hydrogen and the fuel-oil distillate streams is carried out in the presence of a catalyst at elevated temperature and pressure.

From the use of hydrogen the distillate fuel oil, according to the authors, is improved as follows:

Sulphur content gives an 80 to 90 per cent desulphurization including essentially complete removal of mercaptan products. These last named cause an objectionable odor and to combat the odor certain treatments were employed in the past that later created storage stability and fuel-compatability problems.

Carbon residues for the 10 per cent bottoms of crudes are said to be lowered 80 to 90 per cent and somewhat similar improvements are held for blends of cracked and uncracked distillates.

Color stability is said to be superior for hydrogen-treated distillates.

Something like a 3-deg API gravity increase has been obtained for hydrogen-treated catalytically cracked distillates and about 1-deg API for virgin straight-run distillates.

Practically all acids such as naphthenic acids are removed. Further, there is said to be greatly intensified resistance to sludge formation in storage. Water-separation characteristics are also improved.

Improvement of Distillate Fuels by Additive and Refining Techniques, by J. P. Kirchner, Donald P. Osterhout, Jr., Mem. ASME, and W. R. Schwindeman, Assoc. Mem. ASME, Socony Mobile Oil Company, Inc., Paulsboro, N. J. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-213** (multilithographed; available to Oct. 1, 1956).

Presenting a somewhat different approach to the problems of fuel-oil sludge and the formation of transparent gel-like deposits resulting from the reaction of mercaptan sulphurs in the oil with the copper in the brass parts of the fuel system, these authors defined the causes of the problem and then commented on the effects of treating oils and specifically using additives to avoid the problems so defined.

Those additives called dispersants or antiscreen clogging agents allow the sludge to pass through strainers or filters but they may produce two to three times as much sludge as an oil without these additives. The second general type of additive, the sediment inhibitor, eliminates or reduces insoluble sludge formation. But, unfortunately, its usefulness as a lone agent is limited and an antiscreen clogging additive must also be employed. The temporary relief they give is offset by possible problems in the operations of the equipment.

In summation the authors surprisingly return to the contention that the proper combination of additives with treating will eliminate the sludge-sediment and sludge-dispersal problems existing in certain oils.

Flow Characteristics of Aerated Crushed Coal, by Charles H. Marks, Mem. ASME, Peter R. Broadley, Mem. ASME, and John I. Yellott, Mem. ASME, Bituminous Coal Research, Inc., Dunkirk, N. Y. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-118** (multilithographed; available to Oct. 1, 1956).

The results of studies to determine the effect of varying degrees of aeration upon the flow characteristics of coals of varying size consists and moisture content were the subject of this paper. It states that air passed at a low velocity through a bed of crushed coal produces significant changes in the flow characteristics of that coal bed. Most important to the authors were (1) a change in the angle of repose from as high as 50 deg to as low as 2 deg, (2) a large increase in rate of coal flow through an opening in the bed. In short, the material took on some of the characteristics of a viscous fluid and the effects became more marked as the minus 50 mesh fraction of the coal particles increased.

The paper discussed the application of this aerated process to the discharge of the crushed coal from flat-bottomed bunkers and then attempted to establish criteria for predicting flow characteristics of crushed coal when the size consist and moisture content were known. The authors explained at length testing equipment, methods, determination of data, and the coals tested, plus more specific details on the static and dynamic behavior of the tested coals. The effect of size consist and moisture content were well discussed.

Pulsating, Pressure-Generating Combustion Systems for Gas Turbines, by F. H. Reynst, Dipl. Ing., Sevres (Seine-et-Oise) France. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-56** (multilithographed; available to Oct. 1, 1956).

Despite the predictions of 20 years ago, the industrial gas turbine has not yet dethroned the piston motor, because it still burns too much fuel. Without regeneration, thermal efficiency of the industrial gas turbine is about 20 per cent, or half the diesel's 40 per cent. A regenerator may improve efficiency to 30 per cent, but this at the price of a much heavier and more voluminous installation. Something else must be found to bring thermal efficiency up to 30 per cent, without resorting to bulky heat exchangers. Has the combustion chamber received as much attention as the other components of the machine, the compressor, for instance?

In today's gas turbines the highest pressure must be built up mechanically, by means of a turbine-driven compressor. This results in low work ratio (percentage of turbine power available as net output) and high internal loss. In the piston engine, on the other hand, pressure is increased automatically by constant-volume combustion. This is an important reason for good thermal efficiency. Another reason is high gas temperature at the beginning of the expansion, no cooling of combustion products by excess air being required. Constant-volume combustion and absence of excess air are the outstanding advantages of the piston engine, of which the principal defects are heat loss to the cooled cylinders, and incomplete expansion. A nice characteristic of the piston engine is also absence of flow work. Compression with flow work (case of the gas turbine) required 1.4 times the amount of power as compression without flow work.

Suppose the ordinary constant-pressure combustion chamber of a gas turbine is replaced by a Lenoir engine, working as a pressure generator. The improved Lenoir engine, burning a stoichiometric mixture and driving an excess-air compressor, has a pressure ratio of nearly 2.0 and improves thermal efficiency from 27.3 to 44.5 per cent.

After establishing this interesting premise, the author proceeded to calculate the

thermal efficiency of two gas turbines for ideal constant-volume combustion and found for a "high-grade" plant 40 per cent at compressor pressure ratio 5 and for a "low-cost" installation 33 per cent at compressor pressure ratio 2.5. Generator efficiency in both cases was about 17.5 per cent.

Then, by assuming a 10 per cent generator efficiency for practical pressure-generating combustion chambers, Mr. Reynst established a thermal efficiency of 33.1 per cent for high grade and 24.7 per cent for low-cost gas turbines. Generator efficiency of 10 per cent corresponds with generator pressure ratio of about 1.6.

Pulsejet engines of V-I design, Mr. Reynst pointed out, may have 15 per cent thermal efficiency at the air temperature prevailing in gas turbines. A 67 per cent converter efficiency is needed to arrive at 10 per cent generator efficiency. The big problem today is how to build converters. Rotating pulsejet engines in a "fire wheel" cannot be the answer, because of centrifugal forces. The author described the pot-with-diffusor combustion which burns the mixture within a whirl and suggests it may hold the answer to pulsating pressure-generating combustion, which Mr. Reynst believed, may open the way toward the true aerodynamic heat engine of the future.

Instruments and Regulators

Effects of Adjacent Piping Configurations on Control-Valve Characteristics and Capacity, by G. F. Brockett, Mem. ASME, Fisher Governor Company, Marshalltown, Iowa, and W. J. L. Kennedy, Stone & Webster Engineering Corporation, Boston, Mass. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-138** (multilithographed; available to Oct. 1, 1956).

In many instances the care used in specifying control valves in the engineering stages of a project, and the efforts of manufactures to provide precise valve characteristics and capacities are partially nullified by poor installation practices. This paper reviews several of the more common control valve-manifold arrangements and points out the ill effects where they occur. It is hoped those responsible for the selection of control valves will be encouraged to extend their responsibility to include a review of the actual installation details.

In the test results the basic capacity of the control valve is plotted for reference. This capacity is measured by taking the pressure drop across the control valve plus the pressure drop due to the two necessary reducers which are located at the inlet and outlet flanges of the control valve. A discussion of standardization for test manifolds for measuring control-valve capacities was presented in a companion paper presented at this symposium.

It is also common practice to include the pressure drop across the entire control-valve manifold under the pressure differential available for control. That is, if 10 psi is allowed for control, 2 psi of this may be used in the piping immediately adjacent to the control valve. The authors have followed this practice in the test results which follow; the control valve and its adjacent piping have been considered a system and treated as a unit in assigning pressure drop and calculating flow. The authors felt it seemed obvious that a reduction in effective capacity of the control valve will result; the fact that this is obvious does not insure that its effects will be compensated for. If it were not true that many control valves are oversized by duplication of safety factors, this effect would be more commonly noticed.

While the results of these tests in so far as capacity reduction is concerned could probably have been predicted, the changes in valve characteristic are not predictable. The present tests used plug valves; other types of valves and fittings could have been used and the results obtained would then depend upon the flow pattern and pressure loss characteristics through them.

It is common practice to reduce the size of the inlet and outlet blocks, as well as to add elbows in the manifold. It can be expected that this will result in impaired capacity and characteristic. The press of time, however, limits the test data which can be included with a reasonable expenditure in time and money.

Gas Turbine Power

Tests of an Experimental Coal-Burning Turbine, by D. L. Mordell, Mem. ASME, and R. W. Foster-Pegg, McGill University, Montreal, Canada. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-158** (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1956).

This paper had its origin in 1949, when one of the authors suggested that by the use of the exhaust-heated cycle for a gas-turbine power plant, the new problems and difficulties then besetting those who were trying to produce a coal-burning gas turbine, including (*a*) Feeding of pulverized coal under pressure; (*b*) burning pulverized coal under pressure; (*c*) gasifying coal under pressure; (*d*) separating ash from high-temperature gases; (*e*) establishing the tolerance of turbine blades to ash erosion might be replaced by two problems different in degree but not in nature from those encountered in the design of boilers, namely, (*a*) combustion of coal in a furnace at essentially atmospheric pressure; (*b*) heating of a compressed gas by transfer of heat from hot combustion products. It appeared that adaptation of the existing technology to the gas-turbine conditions should prove easier than the evolution of a completely new technology. It was recognized, however, that the differences in degree made it impossible to design, with confidence, a power plant which might be expected to be immediately successful. It was, therefore, suggested that a purely experimental plant should be designed, constructed, and tested, to lay the foundations for a future successful design.

Representatives of the two major Canadian railroads considered that this proposal might lead to the evolution of a coal-burning gas-turbine locomotive that would play a useful part in their operations. The Dominion Coal Board felt that such a program might lead to the development of improved ways of utilizing coal and thereby effectively help the Canadian coal industry. The Department of Mines and Technical Surveys then placed a contract with McGill University for such a program, to be carried out under the senior author's direction. Since that time a vast amount of work has been done. The experimental plant has been built and has now completed its first series of tests. A great deal of theoretical design and economic consideration has been given to possible applications. The present paper reviews what has been done, and discusses the lessons that have been learned and their application in the future.

It is perhaps a little early to make definite conclusions but this first test series has firmly established that the exhaust-heated cycle is a perfectly feasible mode of operation for a coal-burning gas turbine. It has, furthermore, been demonstrated that it is a particularly rugged machine, capable of operating under conditions of considerable maladjustment and deterioration of components.

Before it could be claimed to be practical, in a commercial sense, as distinct from technically practicable, it remains to be shown that the problems encountered can be resolved and that the heat is not too expensive. As a result of the work already done, no fear is held that the difficulties cannot be solved, and it is hoped that the next test series, due to

commence in October 1955, will show a large step forward and at the end of which manufacture of an industrial plant giving every hope of successful commercial performance could be considered. It must be remembered that the problems are essentially those which the boilermakers have already solved. As to the cost factor, studies show that the heater cost is far from prohibitive in applications requiring relatively small powers, i.e., less than 5000–75,000 kw.

Transient Temperature and Thermal Stress in Locomotive Gas-Turbine Buckets, by Mrs. F. F. Buckland, Mem. ASME, and J. B. Gatzemeyer, General Electric Company, Schenectady, N. Y. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-179** (multilithographed; available to Oct. 1, 1956).

THE basis for this paper was an inspection of the first-stage buckets of a locomotive gas turbine which had revealed that a majority of these buckets had cracks in the leading edge apparently caused by thermal fatigue. To substantiate this conclusion a theoretical investigation of the temperature distribution and resulting distribution during the operating-cycle transients was made.

The method of calculating the temperature and stress distribution was described. It related the actual operating experience to the calculations, pointed out the influence of proper engine control in limiting the conditions causing thermal stress, and discussed the use of calculated stresses in predicting the operating life from existing data on the material properties.

Effect of Turbine-Blade Cooling on Efficiency of a Simple Gas-Turbine Power Plant, by W. M. Rohsenow, Mem. ASME, Massachusetts Institute of Technology, Cambridge, Mass. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-120** (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1956).

THE paper covered an investigation of the effects of blade cooling on the thermodynamic performance of a simple gas-turbine plant.

The efficiency of a simple gas-turbine cycle can be increased by designing it to operate at higher turbine-inlet temperatures. In order to operate these turbines at higher temperatures it is necessary to cool the blades, and possibly the casing and rotors, in the earlier stages until the gases are reduced to a value between 1000 and 1500 F depending on the kind of metal employed. Various methods of cooling turbine blades have been investigated by the NACA and published in various unclassified technical reports since 1947.

Heat Transfer

Free-Convection Heat Transfer From a Horizontal Right Circular Cylinder To Freon 12 Near the Critical State, by D. L. Doughty, Assoc. Mem. ASME, Shell Development Corporation, Emeryville, Calif., and R. M. Drake, Jr., Mem. ASME, General Electric Company, Cincinnati, Ohio. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-100** (multilithographed; to be published in Trans. ASME; available to Oct. 1, 1956).

FREE-CONVECTION heat-transfer coefficients have been measured on a horizontal circular cylinder to Freon 12 near the critical-state conditions as a function of the temperature difference between the test cylinder and the Freon environment. Experimental heat-transfer coefficients have been determined for constant Freon temperatures of 233, 244, and 259 F, and for a constant pressure of 580 psia, the critical pressure of Freon 12. In all cases the heat-transfer coefficients have been determined as functions of the temperature difference between the test cylinder and the Freon for densities varying from supercritical to subcritical. In the region near the critical state the experimental heat-transfer coefficients are shown to increase tenfold over the typical values in the superheated vapor region.

Satisfactory correlation of the present results with the work of other investigators in the field of free-convection heat transfer has been made for state conditions removed from the critical.

The Determination of Heat-Transfer Coefficients for Air and Carbon Dioxide, by E. L. Katz, Convair, San Diego, Calif. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-101** (multilithographed; available to Oct. 1, 1956).

AN experimental investigation was conducted for determining the convection and radiation heat-transfer coefficients for pure dry air and pure gaseous carbon dioxide flowing turbulently through a small-diameter water-cooled tube. The experimental results are correlated with an average deviation of ±8 per cent by an equation.

Data were obtained over a static gas-pressure range of 50 to 250 psia, an average gas-bulk temperature range of 597 to 1778 F, and a Reynolds number range of 8300 to 140,000.

The total heat-transfer coefficients for carbon dioxide, which contain both radiation and convection components, are shown to be numerically less than the pure convective coefficients for air at the same conditions of temperature, pressure, and Reynolds number. The total coefficients for CO_2 are shown to be affected by pressure at high bulk temperatures. For example, at an average bulk temperature of 1550 F, the total coefficient decreased 9 per cent when the pressure was increased from 50 to 200 psia.

Combined Forced and Free-Convective Heat Transfer in a Horizontal Pipe, by J. J. Martin, Bendix Aviation Corporation, Mishawaka, Ind., and M. B. Carmichael, Esso Standard Oil Company, Baton Rouge, La. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-30** (multilithographed; available to Oct. 1, 1956).

A SUMMARY of previous analytical and experimental work associated with the determination of local convective coefficients for laminar flow in a horizontal tube is presented.

In addition, the results of experimentation are reported on local coefficients both with and without a hydrodynamic entrance section, water being the test fluid, and with special reference to the effect of free convection.

Engineering Relations for Heat Transfer and Friction in High-Velocity Laminar and Turbulent Boundary-Layer Flow Over Surfaces With Constant Pressure and Temperature, by E. R. G. Eckert, Mem. ASME, University of Minnesota, Minneapolis, Minn. 1955 ASME Diamond Jubilee Annual Meeting paper No. **55—A-31** (in type; to be published in Trans. ASME; available to Oct. 1, 1956).

RELATIONS are presented which permit a rapid calculation of friction and heat transfer from two-dimensional high-velocity flow to surfaces with locally constant pressure and temperature and with laminar and turbulent boundary layers. The calculation procedure is one which has been well established in the field of heat transfer, namely, to use equations for friction and heat-transfer parameters which have been developed for constant-property fluids and to adapt them to conditions where properties vary in such a way that those properties are introduced into the equations at a properly determined reference temperature. Relations are developed for this reference temperature which make the results of the outlined method agree best with published laminar boundary-layer solutions. The same relations turn out to give also good representation of measured results on turbulent boundary layers.

The following advantages are connected with this particular method. It gives answers by simple calculations and it is quite generally applicable. The friction and heat-transfer equations are valid for any fluid gas or liquid. The relation for the reference temperature (or enthalpy), gives very good agreement with boundary-layer solutions regardless of the specific variation of the property values on which the calculations had been based. Therefore it may be expected that they are not only valid for air at any pressure and temperature level (as long as slip flow and dissociation are avoided) but approximate real conditions well also for other gases.

The Viscosity of Steam, Heavy-Water Vapor, and Argon at Atmospheric Pressure Up to High Temperatures, by C. F. Bonilla, Columbia University, New York, N. Y., S. J. Wang, Air Products Inc., Emmaus, Pa., and H. Weiner, U. S. Army, Camp Detrick, Md. 1955 ASME Diamond Jubilee Annual Meeting paper No. 55—A-6 (in type; to be published in Trans. ASME; available to Oct. 1, 1956).

Because of the increasing emphasis on high-temperature processes and high-speed flight, the physical properties of gases at high temperatures and atmospheric pressures have acquired considerable importance.

A recent study of the viscosity of steam was carried out over the range of 450 to 1200 deg C in a heat-jacketed apparatus. At that point failure of refractory supports in the furnace precluded higher and lower-temperature runs. It was decided to repeat this work with the same type of capillary efflux viscometer but a stronger support for the capillary and also cover lower and higher temperatures.

The viscosity of D_2O vapor, not found in the literature, was also determined. In addition, the viscosity of argon was measured, in view of expressed doubts as to the accuracy of Vasilesco's results.

ASME Transactions

for February, 1956

The February, 1956, issue of the Transactions of the ASME (available at $1 per copy to ASME members; $1.50 to nonmembers), contains the following technical papers:

Oil and Gas-Well Casing Suspension Assemblies, by A. F. Rhodes and J. C. Wilhoit, Jr. (55—PET-27)

Study of Pneumatic Processes in the Continuous Control of Motion With Compressed Air—I, by J. L. Shearer. (55—IRD-4)

Study of Pneumatic Processes in the Continuous Control of Motion With Compressed Air—II, by J. L. Shearer. (55—IRD-10)

Dynamic Analysis of Chemical Processes, by E. G. Holzmann. (55—IRD-5)

Determination of System Characteristics From Normal Operating Records, by T. P. Goodman and J. B. Reswick. (55—IRD-1)

The Chemical Deaeration of Boiler Water—The Use of Hydrazine Compounds, by J. Leicester. (54—A-123)

Controlling Iron and Copper Pickup With Neutralizing Amines, by J. D. Ristroph and E. A. Yorkgitis. (54—A-262)

Hydrazine as an Oxygen Scavenger—A Progress Report on Tests at Springdale Station, by M. D. Baker and V. M. Marcy. (54—A-261)

Lower Flue-Gas Exit Temperatures Through Removal of the Solids Ahead of the Air Preheater, by A. J. Tigges and H. Karlsson. (54—A-247)

Design Aspects of an Electrostatic Precipitator for the Collection of Small Solids Ahead of the Air Heater, by H. Klemperer and J. E. Sayers. (54—A-248)

Investigations Into Blade-Root Fixings of High-Temperature Steels, by W. Siegfried. (54—A-236)

Factors Influencing the Notch Fatigue Strengthening of N-155 Alloy at Elevated Temperatures, by Walter S. Hyler and Ward F. Simmons. (54—A-239)

Factors Influencing the Notch-Rupture Strength of Heat-Resistant Alloys at Elevated Temperatures, by R. L. Carlson, R. J. MacDonald, and Ward F. Simmons. (54—A-240)

Orifice Coefficients for Reynolds Numbers From 4 to 50,000, by H. W. Iversen.

Discharge Measurements at Low Reynolds Numbers—Special Devices, by A. L. Jorissen. (54—A-190)

Effect of a Globe Valve in Approach Piping on Orifice-Meter Accuracy, by J. W. Murdock, C. J. Foltz, and Clarence Gregory, Jr. (54—A-122)

Flow of Saturated Boiler Water Through Knife-Edge Orifices in Series, by Elmer S. Monroe, Jr. (54—A-118)

Notes on Some Recently Published Experiments on Orifice Meters, by E. Buckingham (deceased). (54—A-244)

The Mechanism of Separation in the Louver-Type Dust Separator, by J. L. Smith, Jr., and M. J. Goglia. (54—A-134)

Plastic Working of Metals, by W. S. Wagner. (54—A-64)

Plasticity Equations and Their Application to Working of Metals in the Work-Hardening Range, by E. G. Thomsen.

Plastic Metalworking, by E. V. Crane.

Performance Characteristics of Francis Type Pump-Turbines, by W. J. McCormack. (55—S-45)

Zirconium-Fabrication Techniques and Alloy Development, by C. E. Lacy and J. H. Keeler. (55—S-43)

Laminar Free Convection From a Vertical Plate With Uniform Surface Heat Flux, by E. M. Sparrow and John L. Gregg. (55—SA-4)

Heat Transfer to Laminar Flow in a Round Tube of Flat Conduit—The Graetz Problem Extended, by John Sellars, Myron Tribus, and John Klein. (55—SA-66)

ASME Papers Order Form

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Note: No digests are made of ASME papers published in full or condensed form in other sections of Mechanical Engineering.

Copies of all ASME publications are on file in the Engineering Societies Library and are indexed by the Engineering Index, Inc., both at 29 West 39th Street, New York, N. Y.

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Reviews of Books

And Notes on Books Received in Engineering Societies Library

Instruments

INSTRUMENTS ENGINEERING, Vol. 3 Part 1. By Charles Stark Draper, Walter McKay, and Sidney Lees. McGraw-Hill Book Co., New York, N. Y., 1955. Cloth, $8\frac{1}{2} \times 11$ in., figs, xxviii and 879 pp., $17.50.

Reviewed by Rufus Oldenburger[1]

THE previous two volumes of "Instrument Engineering" by the same authors have been concerned with fundamental theory. The present book is devoted to the problem of measurement. The case method of presentation is employed with particular emphasis on examples involving temperature, pressure, and vibration. A discussion of electromechanical units leads to the subject of oscillographs for observing and recording the values of the measured variable. A treatment of integrators and differentiators precedes an exposition on the use of analog computers for studying instrument problems.

Where use is made of material from volumes 1 and 2 the results are often repeated so that volume 3 is a relatively self-contained unit. The book assumes a knowledge of basic physics and differential equations. Physical components are described by drawings of the equipment, differential equations relating inputs and outputs, and curves showing the output responses to sinusoidal, ramp, step, and pulse inputs. These characteristics should be of considerable value in the selection of devices for measurement, and the synthesis of systems involving such devices. Typical examples of current specifications for instruments are given so that the reader can obtain a picture of the factors involved in the problem of supplying the customer with equipment to fit his needs. Concern is given to the matter of employing a terminology that is precise and can be readily understood by engineers and scientists of all kinds.

Volume 3 follows the style of the previous ones in that blocked summaries of mathematical formulas and other pertinent information occur throughout the text. The book is printed in offset. The exposition is lucid and the treatment thorough. This and the previous volumes of "Instrument Engineering" are valuable sources of information for both the beginner and expert in the field of instrumentation and automatic control and should facilitate the use of scientific methods in this important area of industry.

[1] Director of Research, Woodward Governor Co., Rockford, Ill. Mem. ASME.

A History of Technology

A HISTORY OF TECHNOLOGY. Vol. 1, From early times to fall of ancient empires. Edited by Charles Singer, et al. Oxford University Press, London, England, 2nd edition, 1955. Cloth $7\frac{1}{2} \times 10$ in., figs., plates, maps, bibliography, index, xlvii and 827 pp., $23.55.

Reviewed by James Kip Finch[2]

THIS is a monumental work (it weighs five pounds) but it is only the first of what promises to be a monumental set that will apparently require a strong shelf for its support. There are over 900 pages between the covers of this first volume; 800 of text, illustrated with almost 600 excellent line drawings, plus an appendix of 36 pages of halftones to further illuminate its story. This Herculean publication, which has been made possible by the British endowment, Imperial Chemical Industries, Limited, is to be followed by four more volumes bringing the story down to the twentieth century—a magnum opus designed "primarily as a contribution to technical education . . . to provide students of technology and applied science with some humane and historical background for their studies."

One's first reaction is, understandably, that of wonder, amazement, and doubt. If it takes 900 pages to bring technology up to c. 500 B. C., will it be possible to cover the later 25 centuries of ever-increasing technological advances in four even as ponderous tomes? Then, as one scans its many pages, the question inevitably arises: What do the editors have in mind by "technology"? This term, at least on this side of the Atlantic, is regarded as more or less another name for engineering. Many of our engineering schools are, in fact, called "institutes of technology." But this colossal British work is not a history of engineering. The editors, in fact, have not only adopted, as stated in their preface, their own definition of technology but also disclaim the intention of producing a history, using that word "in its ordinary sense." This huge volume thus turns out to be not a history of engineering but a most interesting chronological study of the origin and development of the tools and techniques of all the early activities of man's material life, useful, ornamental, and other, including the use of cosmetics and the practice of embalming. Only medicine, architecture, and "certain other arts" escape, in the belief that they have been "adequately treated elsewhere."

We are told that "technology is a term the range of which it is the purpose of this book to indicate." And, while it is admitted that "It is necessary, in the interests of intelligibility, to relate the development of any human activity to the leading events of political and economic history," this responsibility has been avoided as "impracticable." In fact, the editors have apparently been led, through their all-inclusive use of the term technology and the fact that some of the many techniques they include were "most highly developed by people who played a relatively minor role in the great historical drama," to conclude that an historical approach is impossible. They state that "the progress of technology does not fit this familiar pattern. It has its own chronology, its own critical phases." In defense of this viewpoint, with which no modern historian would agree, they cite the Phoenicians (the alphabet and ivory work) and the Etruscans (fine gold work) "whose culture was early overwhelmed and absorbed by the growing might of Rome." This, we believe, is the first time "technology" has been credited with the alphabet or the artistic working of ivory and gold.

The reader, therefore, who, thinking this a history of technology, passes over the preface, may secure a completely erroneous viewpoint not only on "What is technology" but on the role of engineering in the rise of western civilization. Who would suspect that, hidden in these pages are the technical beginnings of a human activity the evolution of which

[2] Dean Emeritus and Renwick Professor Emeritus of Civil Engineering, Columbia University, New York, N. Y.

has not only been concurrent with the main stream of human history, but had profoundly affected man's relationship both to his dwelling place and to his fellow men even before 500 B. C.—an activity which, in recent centuries, has completely transformed our economic way of life and our social order. What "humane and historical background," it may well be asked, can such an all-embracing yet narrowly limited study provide for the student of technology?

When one turns to the contents of this remarkable volume, however, he cannot fail to find many most interesting and revealing descriptions of the origin and growth of early techniques. Here the results of the most recent discoveries, studies, and researches are summarized. The book comprises 31 sections or chapters, each written by a scientific expert, and forming seven parts: Basic Social Factors, Food Collecting Stage, Domestic Activities, Specializing Industries, Utilization of Metals, Transport, and a final chapter, The Preparation for Science. The area spanned is from the advent of Homo sapiens to the Fall of Ancient Empires—meaning the really ancient empires, not Greece and Rome. It begins with the "Use of Tools by the Lower Animals," passes on to the apes and a discussion of "the uniqueness of human skills," covers the Stone, Bronze, and Iron Ages, the domestication of animals, pottery, basketry, textiles, building in brick and stone, water supply, wheeled vehicles, and boats and ships. There are also essays on social organization and other speculations of the "background" type.

The engineer would, of course, take exception to the suggestion of the social scientist who appears to hold that technology is a social product rather than a basic instrument of social change. He would also question the idea that "a knowledge of the properties of materials, of natural laws and forces" came first and application to man's needs and wants followed. Certainly the early history of engineering reveals quite the reverse. Experience, actual try-it-and-see, was the great teacher. "How" preceded "why"?

Yet the sections on Brick and Stone Masonry, on Water Supply and Irrigation, on Extracting, Smelting, and Alloying Metals, and on Transport, are most interesting and informative. Here again one notes the extremely early origin of many tools and methods. The amazingly early mastery of such metal techniques as molding, and even core casting, the sinking, raising, and stamping of sheet-metal work, and the soldering and inlaying of the early metals—gold, silver, copper, bronze—is especially surprising. These were all in use before 2500 B.C., with skills difficult to duplicate today. Iron came later but iron welding was employed as early as 1350 B.C.

While, therefore, this work is disappointing to one who is seeking what, "in American," would be called a History of Technology, it is a most interesting and up-to-date record of man's earliest discoveries and inventions in his efforts better to meet the demands and interests of civilized life.

Books Received in Library

AEROELASTICITY. By Raymond L. Bisplinghoff, Holt Ashley, and Robert L. Halfman. Addison-Wesley Publishing Company, Inc., Cambridge, Mass., 1955. 860 p., $9^1/_4 \times 6^1/_4$ in., bound. $14.50. In the first part of this book which is divided roughly into halves, the authors present analytical methods for dealing with problems of aircraft structures under load, and problems of two and three-dimensional incompressible flow, compressible flow, and three-dimensional unsteady flow. In the second part, these methods are applied to practical problems of static aeroelasticity, flutter, and dynamic response phenomena. The theory, design, and construction of models, and experimental techniques are also dealt with briefly. The book is intended for advanced students and practicing engineers.

ANNUAL REVIEW OF NUCLEAR SCIENCE. Vol. 5, 1955. Edited by James G. Beckerley. Annual Reviews, Stanford, Calif., 1955. 448 p., 9 × 6 in., bound. $7. The present volume contains reviews of advances in fourteen areas of the field, accompanied by extensive lists of cited references. Typical papers deal with radiation shielding, nuclear-particle detection, design comparison of reactors for research, and mass spectrometry. Author and subject indexes to this year's volume, and indexes to chapter, authors, and titles of volumes one to five are included.

ATOMIC PHYSICS. By Gaylord P. Harnwell and William E. Stephens. McGraw-Hill Book Company, Inc., New York, N. Y., 1955. 401 p., $9^1/_4 \times 6^1/_4$ in., bound. $8. Using as a point of departure the aspects of classical physics essential to the concepts on which atomic theory is based, this book presents the fundamental physical ideas relating to the nature of matter and radiation, atomic structure, electron spin, polyelectronic atoms, and molecular structure. Two chapters are devoted to the statistical description of elementary particles and to those properties of solids, liquids, and gases capable of being dealt with by the current theory on an elementary mathematical level.

BALL BEARING MAINTENANCE. By Johnny Riddle. University of Oklahoma Press, Norman, Okla., 1955. 170 p., $9^1/_4 \times 6^1/_8$ in., bound. $6. This practical manual for users of ball bearings concisely presents the information needed to ensure good performance and balanced-service life. Its ten short chapters are devoted to nomenclature, metallurgy, and other general information; basic types; common failures and their causes; handling during assembly; preparing the shaft for mounting; locking devices; housings; installation; lubrication; and duplex-bearing problems. The text is fully illustrated with photographs and diagrammatic sketches.

COMBUSTION PROCESSES. (High-Speed Aerodynamics and Jet Propulsion, vol. 2.) Edited by B. Lewis, R. N. Pease, and H. S. Taylor, Princeton University Press, Princeton, N. J., 1956. 662 p., $9^1/_4 \times 6^1/_2$ in., bound. $12.50. This volume deals with subjects basic to the understanding of the role of combustion in propulsion processes: thermodynamics of combustion; chemical kinetics of combustion; oxidation and flame propagation in gaseous systems; the combustion of liquid and solid fuels and propellants; detonation processes; and energy production by nuclear reactions. Current theories and unsolved problems in each of these fields are treated in separate sections comprised of contributions from a number of specialists and accompanied by extensive lists of cited references.

DAVISON'S TEXTILE BLUE BOOK. 90th year, July 1955. Davison Publishing Company, Ridgewood, N. J., 1955. 1349 p., $8^1/_8 \times 5$ in., bound. $6.50. A standard guide to cotton, wool, worsted, silk, synthetic yarn, and fabric manufacturers; hosiery, knit goods, and other mills; textile exporters; fiber and yarn dealers; and others associated with the industry. Chief officers of companies are listed, and where pertinent, the number of machines operated is given. The main listings are geographical and a mill index is provided.

HIGH VACUUM TECHNIQUE. By J. Yarwood. John Wiley & Sons, Inc., New York, N. Y., third edition, 1955. 208 p., $8^1/_8 \times 5^1/_2$ in., bound. $5.50. This is a concise presentation of standard techniques for producing and measuring high vacuums and a description of the latest developments in apparatus, materials, and applications. Among the applications discussed are exhausting radio tubes, the deposition of metal films, and evaporation. New material in this edition includes an analysis of American and British vacuum pumps, details of large diffusion pumps, and information on a number of innovations in methods.

HYDRAULIC AND PNEUMATIC POWER FOR PRODUCTION. By Harry L. Stewart. Industrial Press, New York, N. Y., 1955. Various paging, $9^1/_4 \times 6^1/_4$ in., bound. $8.50. This is a concise but detailed treatment of the various types of fluid power equipment, along with descriptions of typical hydraulic and pneumatic circuits. Fluids, accumulators, power lines, valves, heat exchangers, packings, etc., are discussed, and chapters are included on dual-pressure hydraulic systems, remote-control pneumatic systems, and systems using air and oil in the same circuit. Safety devices and control circuits are also covered.

INTRODUCTION TO REACTOR PHYSICS. By D. J. Littler and J. F. Raffle. McGraw-Hill Book Company, Inc., New York, N. Y., 1955. 196 p., $8^1/_4 \times 5^1/_2$ in., bound. $4.50. A detailed presentation of the calculations used in evaluating the critical size of a gas-cooled, graphite-moderated, natural-uranium reactor of the type intended for use in the nuclear-energy-power program of the United Kingdom. The book also includes an account of the nuclear physics essential for an understanding of the construction principles and sufficient theory for an understanding of the problems involved in the construction of other types of reactors. Separate chapters are devoted to shielding, instruments, and radiation damage to structural materials.

KNIFE-EDGE BEARINGS. (Bibliographic Survey of Instrument Parts, No. 2.) By P. J.

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Geary. British Scientific Instrument Research Association, Chislehurst, Kent, England, 1955. 61 p., 9½ × 6 in., paper. 10s6d. A bibliography of 166 references with a 29-page technical introduction dealing with the different aspects of the subject covered by the literature cited: materials, contact surfaces, friction, mounting, compound bearings, etc. In the bibliography, presented in three parts, principal texts are given relatively full abstracts, secondary references are briefly annotated, and supplementary references are listed without comment.

KORROSION UND KORROSIONSSCHUTZ. Edited by Fritz Tödt. Walter de Gruyter & Co., Berlin, Germany, 1955. 1102 p., 9¾ × 6¾ in., bound. 168 DM. A comprehensive reference book for engineers in all fields on all aspects of corrosion and corrosion protection. (On page 99 of the January, 1956, issue of MECHANICAL ENGINEERING, the price was mistakenly given as 68 DM.)

MASS-TRANSFER OPERATIONS. By Robert E. Treybal. McGraw-Hill Book Company, Inc., New York, N. Y., 1955. 666 p., 9¼ × 6¼ in., bound. $9.50. The first part of this five-part book is a discussion of basic considerations of diffusion rates: molecular diffusion in fluids, diffusion in turbulent flow; diffusion in solids, and interphase mass transfer. These basic considerations are applied in the succeeding three parts to gas-liquid, liquid-liquid, and solid-fluid operations, and the final part deals with contact of miscible phases. In treating the various unit operations—dehumidification, gas absorption, ion exchange, etc.—both theoretical material and principles of the design and operation of equipment are presented.

MECHANISM. By Joseph Stiles Beggs. McGraw-Hill Book Company, Inc., New York, N. Y., 1955. 418 p., 9¼ × 6¼ in., bound. $6.50. In this advanced text for graduate students and practicing engineers, the author uses the classical vector equations of relative acceleration and velocity in the analysis of mechanisms. Factors affecting design are dealt with, and separate chapters are devoted to gears, cams, rotary drives, linkages, computing mechanisms, control of mechanisms, and other topics. One chapter deals with Newtonian mechanics of rigid bodies, and the concluding chapter is a collection of illustrations of various mechanisms grouped by the types of movement they produce.

MOTION AND TIME STUDY. By Gerald Nadler. McGraw-Hill Book Company, Inc., New York, N. Y., 1955. 612 p., 9¼ × 6 in., bound. $7.50. A presentation of modern techniques detailed enough to meet the needs of most industries and activities, with illustrations to point out how these techniques can be modified in particular circumstances. The concept of "operator" has been expanded in this book to include anyone from president to worker, and product design, material specifications, equipment, purchasing procedure, etc., are included with human motions as areas to which motion and time study can be applied. A problem section is provided at the end of the text.

POWDER METALLURGY. (Technical Assistance Mission No. 141.) Organization for (European Economic Co-Operation, Paris, France (U. S. agent-O.E.E.C. Mission, Suite 61, 2002 P Street, Washington 6, D. C.), 1955. 309 p., 9⅜ × 6 in., paper. $3. A report of a survey of the industry in the United States, made by representatives of seven European countries. The main body of the report deals with electrical and magnetic applications, hard metals, tungsten wire, cermets, engineering powders, the manufacture of structural parts, pressing processes, furnaces, standards, and quality control. Several pertinent specifications and a four-page bibliography are included.

PRINCIPLES OF FARM MACHINERY. By Roy Bainer, R. A. Kepner, and E. L. Barger. John Wiley & Sons, Inc., New York, N. Y., 1955. 571 p., 8¾ × 5¾ in., bound. $8.75. The more common types of field machines are treated in this book on the basis of the unit operations performed by the functional elements of the machines, with only a minimum of descriptive material presented. Machines for tillage, disking, planting, cultivating, and the various other farming practices are dealt with, and general discussions of materials, power transmission, hydraulic controls, and economics are included. Reference lists at the ends of the chapters provide a guide to more detailed studies of particular subjects.

PRINCIPLES OF HELICOPTER ENGINEERING. By Jacob Shapiro. McGraw-Hill Book Company, Inc., New York, N. Y., 1955. 433 p., 9¼ × 6¼ in., bound. $12.50. Both theoretical and practical aspects of helicopter design are treated in six chapters dealing with the following topics: rotating wings in steady flight; helicopter performance; aerodynamics of rotors; mechanics of helicopter flight; design considerations; the complete machine; and components and assemblies. The book covers nearly all types of helicopters as well as such recent advances as turbine drive, jet drive, and compounding of helicopters and fixed wings.

PRINCIPLES OF METAL CASTING. By Richard W. Heine and Philip C. Rosenthal. McGraw-Hill Book Company, Inc., New York, N. Y., 1955. 639 p., 9¼ × 6¼ in., bound. $7.50. This text provides material for a general-foundry-survey course for mechanical-engineering students and for a detailed course in foundry metallurgy for metallurgical-engineering students. Principles of processes and materials, solidification, casting, etc., are discussed in the first eleven chapters, and the succeeding fourteen chapters deal with the casting of specific metals and alloys. A number of recent advances in the field are covered, including new methods of calculating the size of risers for feeding castings and application of the principles of fluid flow to the gating of castings.

PROCEEDINGS OF THE SECOND NATIONAL TURBINE POWERED AIR TRANSPORTATION MEETING. Sponsored by the Institute of the Aeronautical Sciences. Institute of the Aeronautical Sciences, New York, N. Y., 1955. 192 p., 11 × 8½ in., paper. $6 (I.A.S. members, $3.50). The papers in these proceedings deal with a number of technical, economic, and other problems involved in the application of turbojet and turboprop engines to air transport. Typical subjects discussed are thrust augmentation of small turbojet engines, the design of several types of turbine-powered transports, the problem of airport noise, and the economics of the DC-8.

PRODUCTION OF HEAVY WATER. Edited by George M. Murphy, Harold C. Urey, and Isidor Kirshenbaum. McGraw-Hill Book Company, Inc., New York, N. Y., 1955. 394 p., 9¼ × 6¼ in., bound. $6.25. The first part of this volume is a report of a survey of heavy-water plants and their operation as they existed at the end of World War II. It contains descriptions of catalytic exchange-electrolytic process, water-distillation, hydrogen-distillation, and some miscellaneous processes for the isolation of heavy water. Part two records the results of a number of pilot-plant studies of the various processes.

REVIEWS OF PETROLEUM TECHNOLOGY. Vol. 14, 1952–1954. Edited by George Sell. Institute of Petroleum, London, England, 1955. 232 p., 9⅛ × 6⅛ in., bound. 35s. Previous volumes in this series provided an annual review of new developments in the main branches of petroleum technology, accompanied by extensive bibliographies. The present volume is the first to be issued under a new plan of publication featuring triennial coverage, fewer individual reports, and more selective bibliographies. The nine chapters included cover advances in drilling, refining, testing, transportation, and other fields.

SCHRIFTENREIHE ANTRIEBSTECHNIK. Heft 2, 3, 6, 10, 14 (text in German). Friedr. Vieweg & Sohn, Braunschweig, Germany. These five issues of a series on gear-drive technology cover the following topics: No. 2. Bevel-gear tables for the dimensioning of straight-toothed bevel gears without total height correction. 31 p., 1955, 9.60 DM; No. 3. Practical design of spur gear teeth. 27 p., 1954, 9.80 DM; No. 6. Profile correlation in the production of cylindrical worm gears, worm hobs, and threads. 30 p., 1954, 7.50 DM; No. 10. Investigation of cylindrical worm gears—influence of tooth shape, module, diameter, and lubricant upon loss of power and safe load. 144 p., 1953, 18.80 DM; No. 14. Fundamentals of planetary gear design. 90 p., 1954, 9.80 DM.

VDI BERICHTE. Vol. 1, Technische Formgebung, 92 p., 19.50 DM; vol. 2: Feinwerktechnik, 80 p., 12.50 DM; vol. 3, Probleme der Strömungstechnik im Maschinenbau, 138 p., 22.50 DM; vol. 4, Schwingungstechnik, 120 p., 25 DM; vol. 5, Getriebetechnik, 128 p., 20.50 DM. Deutscher Ingenieur Verlag, Düsseldorf, Germany, 1955, 11¾ × 8¼ in., paper. These several volumes of a series presenting papers given at various meetings cover, respectively, the following: (1) Industrial design in machine-tool building, office-machine construction, the electrical industry, etc., with emphasis on co-operation between the design engineer and the industrial designer; (2) precision engineering in connection with typewriter mechanisms, fractional horsepower motors and pneumatic devices, and lubrication problems in precision work; (3) problems of fluid flow in mechanical engineering, covering cascade and blade problems, gas and hydrodynamics, and mechanics of similitude; (4) vibration theory, testing effects, applications, and elimination; (5) kinematics and mechanisms, covering theoretical analysis and synthesis, application to the development of electric-locomotive drives, and design tables for establishing dimensions of like mechanisms.

ASME News

With Notes on the Engineering Profession

E. S. Newman, *News Editor*

Partial view of ASME delegates attending ASME Technology Executives Conference at the University of Michigan, Ann Arbor, January 30 and 31, 1956

Professional Divisions, Meetings, Publications, and Research Committees Air Problems at 1956 ASME Technology Executives Conference

Some 75 ASME Committee members and executives went back to school on Jan. 30 and 31, 1956, to attend the ASME Technology Executives Conference which was held this year at the University of Michigan in Ann Arbor. The Rackham Amphitheater on the University Campus served as the classroom for the discussion which related to the Board on Technology and the Professional Divisions, Publications, Meetings, and Research Committees.

Besides the provision by the University of Michigan of its splendid facilities, R. G. Folsom, director of the University's Engineering Research Institute, and his staff arranged the details of the program so that smooth operation of the conference was assured.

Included in the two-day program were two luncheons, a dinner on Monday evening at which N. L. Bean of Ford Motor Company gave his impressions of Russian automation gained during his recent visit to the USSR, (see page 295 in this issue) and the tours to various points of interest on the University Campus on Thursday afternoon.

A. W. Thorson, chairman, ASME Board on Technology, served as general chairman of the Conference and J. C. Peters, chairman, ASME Professional Divisions Committee, acted as co-chairman.

A. W. Thorson Opens Conference

A. W. Thorson opened the Conference on Monday morning by welcoming the delegates on behalf of the Board on Technology. He introduced Marvin L. Niehuss, vice-president and Dean of Faculty, who brought the official greetings of the University of Michigan. Dean Niehuss gave a brief historical outline of the University and described some of the new projects now under way on the newly acquired North Campus.

In his response, ASME President Joseph W. Barker expressed the appreciation of ASME for the courtesies extended by the University. Dr. Barker also cited the many important people who served the University, including Andrew D. White, first president of Cornell University, and Dean Mortimer E. Cooley who did much as ASME President in 1919 to further mechanical engineering.

Organization and Aims of ASME

In the first formal presentation of the Conference program President Barker discussed the organization and aims of the Society. He emphasized that ASME must be ready to embark on new fields, for example atomic energy.

Presentations at Monday morning sessions were made by ASME President J. W. Barker, *seated;* A. W. Thorson, *standing;* and J. C. Peters, *right*

He especially noted that the Professional Divisions must be ever alert to new problems. Touching on the formation of splinter groups, President Barker said that the Founder Societies are too slow in grasping new technical areas, thus resulting in the formation of new societies and organizations.

We should take a look at new developments —far over the horizon—for example: Solar energy, long-range weather prediction, and the like. ASME, he pointed out, should constantly be aware of basic science developments such as these.

Dr. Barker also covered such points as how to meet the divergent problems which face ASME in Sections and Divisions; the young engineer; and professional developments.

Turning to organization, Dr. Barker noted that perhaps ASME is becoming overly complex at a time when simplicity is desirable.

For example, many meetings are becoming too large and varied. He questioned whether Annual Meetings shouldn't be symposiums with the purely technical presentations left to Division Conferences.

The Section meetings, Dr. Barker stated, can be run on a social or professional division basis.

Dr. Barker concluded that without a strong technical platform the Society cannot exist. However, without a social aspect the Society can also wither.

Purpose of Conference

The purpose of the annual Conference, according to Mr. Thorson, is to provide guidance to Professional Divisions, Publications, Meetings, and Research Committee members, to aid them in carrying out the policies and aims of the Society. The Board on Technology, he pointed out, is charged by the Council to carry on the technical life of ASME through the foregoing Committees. Mr. Thorson emphasized that complete authority and autonomy have been delegated to these Committees.

In addition, he said, special Committees are also formed, such as the Nuclear Energy Applications Committee, which kept a watchful eye on developments in atomic energy.

Mr. Thorson also touched on the current student-member situation. There has been a gradual decrease in our student membership and this problem is now under study, he said.

Establishment of a Technical Development Committee was also under consideration by the Board, Mr. Thorson said. The function of such a committee would be to contemplate and anticipate changes in technology to the end that the Society may have a forward-looking plan in creating new Sections or Divisions to fit the needs of the mechanical-engineering profession. Such a committee, Mr. Thorson declared, is necessary to the development of ASME.

Such areas of technology as solar energy and nuclear fission were cited by Mr. Thorson as subjects that might warrant further study by ASME.

Professional Divisions

In discussing the Professional Divisions and their relation to the other units of ASME, J. C. Peters pointed out that the principal way in which a Division promotes the arts and sciences of a particular branch of engineering is by encouraging, reviewing, and sponsoring the presentation of papers at national meetings. These meetings include Division Conferences limited to the interest of one or more Divisions and such joint meetings as may be arranged with outside organizations interested in the same field. Division Conferences—which are specialized national meetings—involve greater Division responsibility than other national meetings.

In addition to functioning in matters related to technical papers in its field, a Division is expected to make recommendations for honor awards and suggest worthy projects to the Research Executive Committee.

Mr. Peters also discussed the question of who is a member of a Professional Division and the relation of a Professional Division with the other committees under the Board on Technology.

The policy of the present Professional Divisions Committee is to give each Division as much freedom in organizing its activities as is consistent with the Constitution, By-Laws, and Rules, and seems reasonable in a professional organization.

Appointment by the Divisions of Associates to the Professional Divisions Committee provides a facility for discussing in a thorough manner problems which may affect more than one Division. Mr. Peters urged that the Associate setup be used to full effect in bringing before the Committee problems with which it should deal.

Relative to Sections, the Professional Divisions review and sponsor most of the ASME technical literature on new developments which either finds its way into publications or is available through deposit of copies in libraries from which photostats may be obtained. This is a service not only to Society members but, in their interest, to the profession as a whole. Those who write the papers are members of Sections and those who attend the national meetings at which they are presented come from Sections. Practically all of the work of the Divisions is in the interest of Section members.

Mr. Peters said that Sections function at the local level to spread technical information and facilitate advantageous professional contacts for Society members. Technical papers sponsored and presented locally may be made available for review and may be recommended for publication in the Society journals.

Sections, he said, are finding it advantageous to schedule one or more highly technical, special-interest meetings a year, the number depending upon the size of the Section and the specialties which predominate in its area. The formation of local specialized-professional-interest groups can be encouraged through the Sections Manual and by a communication from Headquarters directed to the new program chairman of the Section at the time he is to begin work on his program—about August 1. At the same time he should be given a list of chairmen of Professional Divisions from whom he could request information if he wished to do so.

When the idea comes from the Section, help from the National Professional Division is rarely needed. One capable local man interested in the specialty can usually find an appropriate speaker. For example, the Philadelphia Section arranged 17 "Professional Divisions" meetings for 1955-1956 by this simple procedure. The only committee meeting required was one to agree on meeting dates.

ASME Publications

On Monday afternoon the Publications Committee, in presentations by Otto de Lorenzi, chairman of the Publications Committee, William E. Reaser and Kerr Atkinson, Committee members, and J. J. Jaklitsch, Jr., associate editor of MECHANICAL ENGINEERING, reviewed the various publications problems that the Committee now has under consideration.

Mr. de Lorenzi led off the discussion by referring to the two Progress Reports which the Publications Committee had submitted to the Board on Technology.

The first report (May 23, 1955), Mr. de Lorenzi said, contained a general statement about the value of Society technical papers and periodical publications and discussed some of the problems they present for solution. This report requested a special appropriation to print papers for which funds had been insufficient, and the continuation, for the present, of pricing and distribution policies now in effect, including the policy of 10 free coupons for every member every year. These requests were granted by the Council.

This report, he pointed out, also described five active Committee projects: (1) Forms for reporting monthly and annual financial statistics; (2) an improved format for multilith copies of meeting papers; (3) a binder for preprints; (4) analysis of returns of the 1954 ASME Membership Survey Questionnaire; and (5) improvement in the form used by reviewers of papers. It also listed other subjects of continuing Committee study, including grouping and pricing policies for Transactions.

The second report (Oct. 17, 1955), Mr. de Lorenzi said, stated that a form for financial operating statements has been devised and is in use; that studies of the new two-column preprint format is progressing (a few 1955 papers were issued in this new format); that action on the binder for preprints must await crystallization of the other general policy matters; that the analysis of some 900 written comments on the Questionnaire is practically ready for study; and that suggested forms for reviewers are now available for study by groups that use them. A tentative proposal for grouping Transactions papers is also included for discussion in this report.

He emphasized that some of the Publications Committee suggestions may have drastic effects on the Meetings, Research, and Professional Divisions Committees and on every program-making agency.

Some of these follow:

1 Reviewers' report form, three suggestions were offered. It was urged that the program-making agencies study the forms and decide which form is best or devise a better one.

2 The deadline-date rule, which reads in part as follows, was discussed: "No papers will be assigned to Transactions unless the manuscripts with illustrations, and recommendations of the sponsoring divisions or committees are in the Editorial Department by the deadline date of the meeting at which the paper is to be presented, so that preprints from Transactions type can be prepared."

3 An attempt to cope with the difficult question of grouping technical papers so that a member may have easy access to those most closely related to his specialty in the form of a proposal now in the early discussion stage, under which "preprints of papers would be grouped by professional divisions and mailed to subscribers prior to the four national meetings of the Society."

Continuing the discussion, Professor Reaser pointed up the magnitude of the Society's publication business which is now more than $1 million per year. To dramatize the vast amount of material published by the Society, Professor Reaser displayed a selected group of ASME periodicals and special publications.

With regard to the technical papers, he urged that greater emphasis be placed on quality and less on quantity.

Professor Reaser also re-emphasized some of the points made by David W. R. Morgan, 1955 ASME President, in his letter of Nov. 11, 1955, to the membership last year. In particular this letter pointed out that our meeting programs are increasing in scope and number. The number of papers presented and the number recommended for publication are growing rapidly. The result is taxing the ingenuity and resources of the Society. Our Board on Technology and our Publications Committee have suggested solutions. They embody: Greater selectivity in accepting papers, both for presentation and publication; better program planning and better administration by committees and staff. They require the usual intelligent co-operation of program-making agencies, review groups, and authors.

Mr. Atkinson, in his talk, tried to answer the constant question of what the member gets for his dues. He pointed out that all members pay dues—some Associate Members, $10, Members, $25, average, $14.85 (for fiscal year 1953–1954). For this, each receives MECHANICAL ENGINEERING, presumably worth at least the price of $7 paid by nonmembers, and free coupons, worth $2, if used. Members have rights to attendance at national meetings without payment of registration fees

W. E. Reaser of the Publications Committee urged that more emphasis be placed on quality rather than quantity with regard to ASME Meeting papers

Publications Committee problems were discussed by, *left to right:* W. E. Reaser, Otto de Lorenzi, Kerr Atkinson, and J. J. Jaklitsch, Jr.

Enjoying one of the coffee breaks provided daily by the University of Michigan are R. G. Folsom, *left*, and R. C. Allen who was chairman of the Planning Committee for the Conference

ASME in world affairs was discussed by C. E. Davies, secretary, ASME, *left*, while Ernest Hartford, consultant, ASME, *right*, outlined the student-member problem

(ranging from $5 to $10) and to combined discounts in subscription rates for *Journal of Applied Mechanics* and Transactions of $6 and to discounts of 20 per cent of the prices for Codes, Standards, and other publications. The value of these rights varies widely with the situation of the individual and with his initiative in exercising them. However, the average is material, and approaching, perhaps 10 per cent of dues. Added to $7 of value in MECHANICAL ENGINEERING this brings the average tangible return from publications to $8 or $9 per member.

With respect to the base contribution, therefore, he said, we have reasonably estimated that an average of at least $8 to $9 of actual tangible value in publications is returned out of average dues of $14.85 per member. The remainder, $6 to $7, is the price of the intangibles returning to the member (indirectly through professional practice) from cultivating the soil wherein technical knowledge, his publications, and his professional contacts flourish.

The importance of meeting deadline dates for receipt of technical papers so that advance copies can be prepared for a given meeting or conference was stressed by Mr. Jaklitsch. He explained why it is necessary for the Editorial Department to receive papers before the deadline dates and how the papers are processed for meetings by the staff. Advance copies of papers are a necessary part of any meeting, he said, because their availability results in a better meeting, livelier discussion, and better service to members who are unable to attend the meetings, by making available to them copies of the papers. (See editorial, page 213.)

Meetings Committee Activities

Speaking for Jess H. Davis, chairman of the Meetings Committee, who was unable to be present, C. W. Parsons outlined the aims of the Committee.

Particular aims, he said, are to give continually improved service to members and improve the quality of meetings.

According to Mr. Parsons, a major idea has been advanced that ASME Spring and Fall Meetings after 1957 be replaced by Division Conferences. Such conferences should result in better service to members having special interests.

Mr. Parsons also reported that certain commercial exhibition companies and at least one Division have requested the Meetings Committee to approve ASME sponsorship. It was suggested that such requests be given further study.

ASME in World Affairs

ASME is involved in a broad and comprehensive program in international affairs, according to C. E. Davies, secretary, ASME, who opened the program on Tuesday morning.

Besides being a member body of the Conference of Engineering Societies of Western Europe and the United States (EUSEC), ASME participates in the World Power Conference (WPC), the International Organization for Standardization (ISO), the International Electrotechnical Commission (IEC), the Pan American Federation of Engineering Societies (UPADI), the International Committee for Scientific Management (CIOS), and holds the secretariat of the International Union of Theoretical and Applied Mechanics.

C. W. Parsons outlined activities and aims of the Meetings Committee

Through its Power Test Code Committees, ASME is carrying the administrative load for three technical committees of IEC: steam turbines, hydraulic turbines, internal-combustion engines. The Society also holds the secretariat of the International Conference on the Properties of Steam, which will hold its fifth conference in London this summer. In addition, the ASME Boiler and Pressure Vessel Committee holds the secretariat of ISO/TC11, a technical committee of the International Organization for Standardization dealing with international rules for boilers.

Unique working relations are also maintained with the Engineering Institute of Canada and The Institution of Mechanical Engineers of England, Mr. Davies said. ASME has an agreement with EIC and holds joint meetings with the Institute. Meetings are also held in co-operation with the IME.

Mr. Davies also touched on Engineers Joint Council and its work in attempting to create an American Federation of Engineering Societies.

ASME Student Members

Ernest Hartford, ASME consultant, in his presentation on the relation of ASME to the Student Membership, urged that careful study be given to the Society's student-membership program. Of great concern, he said, is the fact that only 28 per cent of ASME Student Members transfer to Associates upon graduation and of these about 50 per cent drop out in their second or third year.

This is an acute problem, Mr. Hartford warned, and warrants prime consideration.

ASME Research

A detailed discussion of the activities of the Executive Research Committee and the Research Planning Committee and their relation to the Professional Divisions was presented by

T. H. Wickenden, chairman of the Research Executive Committee.

The Research Executive Committee is mainly a policymaking body and reports to the Board on Technology. It consists of five members each serving a five-year term.

The Research Planning Committee reports to the Research Executive Committee and is responsible for bringing in new research projects, keeping existing programs active, and recommending the discharge of individual research committees when their activities have ceased.

The present organizational setup of the Research Executive Committee and the Research Planning Committee was initiated in 1952, although some of the research committees have been established for a great many years, Mr. Wickenden explained. There really are two types of committees existing under the name of Research Committees which have different lines of interest, he said. Of the 17 research committees, 11 have one or more cooperative research projects for which they are responsible. The others might be classified as Research Study Committees, or Research Review Committees; their main objective is to keep their Professional Division members up to date by reviewing literature, especially new developments in their line of interest and seeking papers to be delivered before the Society. These two types of committees are important, Mr. Wickenden said, and their interests are interrelated to some extent. The whole area is being explored and studied so that their operation and procedure will be well defined.

The first step in any research project, according to Mr. Wickenden, is to review the literature to learn what facts are known, what new information has been developed, and the difficulties that have been encountered in previous work.

This type of study could be carried on by either of the two groups. If an area for a new research project is uncovered by the study or review group, then the proper step should be taken to present the project to the Research Planning Committee. If the project is of interest to that Division alone, the Board would probably recommend a subcommittee of the Divisions Research Committee and might include members of the research study group. If a broader interest exists covering several Divisions, a special project committee would be appointed, made up of suitable representatives and reporting to the Research Planning Committee.

Research Committee Operation

How a large research committee operates was discussed by S. R. Beitler, chairman, Research Committee on Fluid Meters. Through a series of slides, Professor Beitler traced the history of the Fluid Meters Committee and how its present organization developed. For example, in 1935 the Committee had 17 members; today it consists of 78 members.

The Committee co-operates with the American Gas Association, American Petroleum Institute, and the International Organization for Standardization (ISO).

How a research review committee operates was covered by W. L. Kennicott, chairman, Research Committee on Metal Processing. This committee, he said, comprises a series of subcommittees each of which covers a phase of metal cutting. The Committee sponsors between four and ten papers at a meeting—some in co-operation with the Production Engineering Division. These papers cover both basic and applied research.

Professional Division Conferences

The organization, budgeting, and financing of Professional Division Conferences was discussed by D. H. Cornell, Professional Divisions Committee; F. W. Hornbruch, Jr., Management Division; and W. T. Reid, Fuels Division.

Professional Division Conferences, Mr. Cornell pointed out, vary considerably in their tone. The theme and content of the program should meet the needs of the sponsoring Division.

Often the conference is strictly an ASME meeting managed by a Division with assistance from a Section. Sometimes, ASME Divisions plan programs jointly with other technical societies or organizations.

The conference, he said, should be keyed to attract a group interested in a specific subject. It is here that specific information can be presented and discussed without conflict with other Society programs.

The conference relieves the load at National Meetings and makes more time available for general-interest papers.

The location and time of the meeting can be selected. The concentration of certain industries often dictate geographical sites for the presentation of particular subjects.

With a properly functioning program committee and the co-operation of the authors, all papers can be preprinted and furnished to all who attend the meeting.

Planning should start at least 18 to 24 months in advance. This allows sufficient time for the Society to budget its portion of the expense. It also takes considerable time to make suitable hotel, meeting-rooms, and program arrangements.

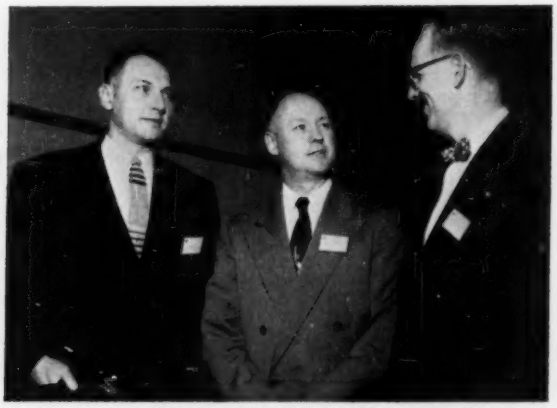
The organizing details are described in Meetings Manual MS-2.

The Host Section should incur no expenses in connection with Division Conferences, since all feature events, such as meals (except authors' meals), trips, entertainment, and women's events arranged by the Section should be self-supporting.

The cost of preprints and authors' meals is defrayed by collecting a conference fee from all registrants—nonmembers usually paying twice the fee paid by members. The amount of the conference fee is determined jointly by the Division and the host Section, and should be just sufficient to provide (*a*) each registrant with a set of available papers, and (*b*) a breakfast for all authors, session chairmen, and vice-chairmen participating in the conference.

Concluding, Mr. Cornell said that the Professional Division Conference offers a real challenge to both ASME management and to the Divisions. Management must maintain a sound framework in which to operate. The Divisions must have sound programming to realize the benefits of a worth-while meeting.

From *left to right:* W. L. Kennicott, S. R. Beitler, and T. H. Wickenden, who discussed various phases of ASME Research Committee Activities



Methods of organizing Professional Division Conferences were outlined by, *left to right:* F. W. Hornbruch, D. H. Cornell, and W. T. Reid

Shown at dinner on Monday evening are, *left to right:* A. C. Pasini, Vice-President, Region V; N. L. Bean of Ford Motor Company, who spoke on his recent visit to Russia; ASME President Barker; and Walker L. Cisler

Fuels

Mr. Reid described the pattern followed by the Joint Solid Fuels Conferences which are held yearly by the ASME Fuels Division and the AIME Coal Division. He outlined the initial planning, detailed planning, technical program, financing, and distribution of surplus.

Management

The Management Division, according to Mr. Hornbruch, sponsors two conferences and co-sponsors a third with the Society for Advancement of Management.

The conferences sponsored by the Division are as follows:

Management Executives Conference. Each October the Division conducts a three-day invitation conference at Skytop, Pa., for executives and their wives. This conference is completely self-supporting and is limited to 100 company officers. It is an off-the-record forum-type meeting wherein management problems at the policy level are discussed. The theme at the ninth annual conference, October, 1955, was "Spotlight on Long-Range Planning." In the main this Management Executives Conference serves top management by assembling men of common interests, but widely varying experiences, and encouraging them to exchange ideas on current and future problems. This is done in an atmosphere completely free from restraint and distractions.

Time Study and Methods Conference. This conference is cosponsored by the Society for Advancement of Management. It is held in New York each April and lasts two days. The conference is designed for managers, supervisors, and engineers interested in industrial-engineering principles and techniques. The program is designed to bring to industrial engineers the latest "know-how" in time and methods study, wage incentives, cost controls, material handling, and production control. Attendance in recent years has ranged between 1400 and 2000 persons.

Engineering Management Conference. In March of each year the Management Division sponsors with a Section a conference of specific interest to engineers concerned with problems of engineering administration. For example, the theme of the third annual conference, March, 1955, was "More Engineering at Less Cost." This conference was first held in Detroit in 1953; then in Philadelphia, 1954; Cleveland, 1955; and will be held in St. Louis, 1956; Pittsburgh, 1957; and Boston, 1958. Each program is designed to help managers of engineers improve their effectiveness in directing research programs, engineering projects, and engineering personnel. Attendance has ranged between 300 and 450 engineers each year.

International Congress of Applied Mechanics in Brussels, Belgium, Sept. 5–13, 1956

The ninth International Congress for Applied Mechanics will be held in Brussels, Belgium, in the buildings of the "Université Libre" from Sept. 5 to Sept. 13, 1956.

The technical sessions of the Congress will be presented in two sections: (1) Fluid dynamics and aerodynamics and (2) Mechanics of solids (rigid dynamics, vibrations, elasticity, and plasticity). Several general lectures are scheduled on subjects of interest to conferees of both sections.

Abstracts of papers should be submitted in three copies to the General Secretariat, IXth International Congress of Applied Mechanics, 50, Avenue F. D. Roosevelt, Brussels, Belgium, before April 15, 1956, in order to permit these abstracts to be selected and printed before the Congress. All abstracts will be included in the book of abstracts. The book will be available upon registration at the Congress for $2.

The American Express Company has been designated as the official travel agency of the Congress. Admission to the applied me-

1956 ASME Regional Student Conferences

	Region	*Place*	*Date*	*Host*
I	New England	Providence, R. I.	April 13–14	Brown University
II	Eastern	New York, N. Y.	April 19	College of the City of New York
III	Alleghenies	Syracuse, N. Y.	April 20–21	Syracuse University
IV	Southern	Clemson, S. C.	March 23–24	Clemson Agricultural College
		(In conjunction with the RAC Meeting, March 24-25)		
V	Midwest	East Lansing, Mich.	April 27–28	Michigan State University
VI	Northern Tier	Fargo, N. Dak.	April 20–21	North Dakota State College
VI	Southern Tier	Rolla, Mo.	April 26–27	Missouri School of Mines & Metallurgy
VII	Pacific Northwest	Pullman, Wash.	May 3–5	Washington State College
VII	Pacific Southwest	Pasadena, Calif.	May 3–5	California Institute of Technology
VIII	Northern Tier	Lawrence, Kan.	April 23–24	University of Kansas
VIII	Southern Tier	College Station, Texas	April 27–28	A&M College of Texas
VIII	Rocky Mountain Tier	Golden, Colo.	April 20–21	Colorado School of Mines

chanics sessions is $4. In the United States advance registration can take place at any of of the American Express Company's offices.

For brochures on the Congress write to the Secretary, The American Society of Mechanical Engineers, 29 West 39th Street, New York 18, N. Y.

ASME Coming Events

March 14–16
ASME Aviation Division Conference, Hotel Statler, Los Angeles, Calif.
(Final date for submitting papers was Nov. 1, 1955)

March 14–15
ASME Engineering Management Conference, Hotel Statler, St. Louis, Mo.
(Final date for submitting papers was Nov. 1, 1955)

March 18–21
ASME Spring Meeting, Multnomah Hotel, Portland, Ore.
(Final date for submitting papers was Nov. 1, 1955)

March 26–28
ASME Instruments and Regulators Division Conference, Princeton University, Princeton, N. J.
(Final date for submitting papers was Nov. 1, 1955)

April 1–5
ASME Oil and Gas Power Division Conference, Jung Hotel, New Orleans, La.
(Final date for submitting papers was Dec. 1, 1955)

April 10–11
ASME Machine Design Division Conference, Bancroft Hotel, Worcester, Mass.
(Final date for submitting papers was Dec. 1, 1955)

April 16–17
ASME Gas Turbine Power Division Conference, Hotel Statler, Washington, D. C.
(Final date for submitting papers was Dec. 1, 1955)

April 26–27
Eleventh Annual ASME-SAM Management-Engineering Conference, Hotel Statler, New York, N. Y.

May 8–11
ASME Metals Engineering-AWS Conference, Hotel Statler, Buffalo, N. Y.
(Final date for submitting papers was Dec. 31, 1955)

May 23–25
ASME-EIC Meeting, Mount Royal Hotel, Montreal, Que., Can.
(Final date for submitting papers was Dec. 31, 1955)

June 11–13
ASME Applied Mechanics Western Division Conference, California Institute of Technology, Pasadena, Calif.
(Papers being accepted until program is filled)

June 14–16
ASME Applied Mechanics Division Conference, University of Illinois, Urbana, Ill.
(Final date for submitting papers was Feb. 1, 1956)

June 17–21
ASME Semi-Annual Meeting, Hotel Statler, Cleveland, Ohio
(Final date for submitting papers was Feb. 1, 1956)

June 19–22
ASME Boiler and Pressure Vessel Committee Out-of-Town Meeting held jointly with the National Board of Boiler and Pressure Vessel Inspectors, Windsor Hotel, Montreal, Que., Can.

Sept. 10–12
ASME Fall Meeting, Cosmopolitan Hotel, Denver, Colo.
(Final date for submitting papers—May 1, 1956)

Sept. 17–21
ASME Instruments and Regulators Division and Instrument Society of America Exhibit and Joint Conference, Coliseum, New York, N. Y.
(Final date for submitting papers—May 1, 1956)

Sept. 23–26
ASME Petroleum Mechanical-Engineering Conference, Conrad Hilton Hotel, Dallas, Texas
(Final date for submitting papers—May 1, 1956)

Oct. 8–10
ASME-ASLE Third Lubrication Conference, Chalfonte-Haddon Hall, Atlantic City, N. J.
(Final date for submitting papers—June 1, 1956)

Oct. 24–25
ASME-AIME Joint Fuels Conference, Sheraton-Park Hotel, Washington, D. C.
(Final date for submitting papers—June 1, 1956)

Nov. 25–30
ASME Annual Meeting, Hotel Statler, New York, N. Y.
Final date for submitting papers—July 1, 1956)
(For Meetings of Other Societies, see page 290)

Motorama Marks First Year of GM Scholarship Plan

General Motors' expanded program of support to higher education marks its first anniversary at the 1956 Motorama with 350 young men and young women already enrolled in college under its benefits.

It was at the opening of the 1955 Motorama that GM President Harlow H. Curtice announced the program—largest ever undertaken by any industrial concern. It has drawn high praise from educators throughout the nation.

When the program is in full operation, GM will be contributing $4.5 million in scholarships and direct support to America's colleges and universities. There will be 1400 holders of awards and, in all, more than 3500 students in institutions of higher education under GM sponsorship (including students at General Motors Institute, Flint, Mich.).

"We are delighted by the universal commendation for the expanded GM scholarship program from educators and students alike," Mr. Curtice declared. "The first group of winners is a splendid group of young men and women who hold high potential for future leadership."

A total of 306 colleges and universities are receiving benefits under the GM program. Private institutions receive annual grants-in-aid equivalent to the tution rate charged and a maximum of $800 per year for each scholarship.

These funds are unrestricted.

Of the 350 scholarships awarded each year, 100 go to winners of national competition among high-school seniors. Nearly 15,000 competed for these awards last year and more than 20,000 have applied for the 1956 awards.

The remaining 250 scholarship winners are selected directly by the 146 educational institutions participating in GM's "college plan." All GM scholarships are for four years, provided the student satisfies educational requirements of the school he or she attends. Scholarships range up to $2000 per year depending upon the individual student's demonstrated need.

Interested students may obtain full information from their school principal's office.

L. K. Sillcox, Convocation Speaker, at VPI Engineering Conference

The seventh annual Engineering Conference will be held on the Virginia Polytechnic Institute campus, Blacksburg, Va., April 26–28, 1956. The theme of the conference is "Engineering, The Summation of the Sciences." L. K. Sillcox, past-president and Hon. Mem. ASME, and honorary vice-chairman of the board, The New York Air Brake Company, New York, N. Y., will deliver the convocation talk, the high light of the conference, at 10:30 a.m. on Friday morning, April 27, in Burruss Hall, to which the entire student body and faculty are invited.

The Engineering Conference, pioneered on the Virginia Tech campus, is sponsored by the Association for the Advancement of Engineering, a student organization, in co-operation with the Dean and faculty of the School of Engineering and Architecture.

A broad and well-rounded program has been developed around the theme of the Conference. In addition to the convocation, symposiums have been developed for each curriculum in the School of Engineering and Architecture. More than 30 technical and professional men from various industries are scheduled to participate. Forty industrial exhibits will feature both national and state industries. A High School Science Show, sponsored by the Virginia Junior Academy of Science, will be held on Saturday morning, after which the more than 1200 high-school students may visit the industrial exhibits and the laboratories of the college.

The crowning of an Engineering Queen will highlight the social aspect of the Conference. Four Virginia Tech coeds will serve as her attendants. A street dance, an Engineering Ball, a banquet, and a tea for the wives of the visiting industrialists and guests are included in the social events to be held.

The current Engineering Conference is the most extensive that has yet been held at the Virginia Polytechnic Institute and is a direct consequence of the increasing contact and mutual exchange of ideas and ideals between professional personnel and industrialists.

ASME Membership

Honorary Members	72
Fellows	403
Members	14,739
Affiliates	300
Associate Members (33 and over)	3,808
Associate Members (30–32)	4,443
Associate Members (to age of 29)	17,306
Total	41,071

ASME to Take Active Part in 1956 American Power Conference, Chicago, Ill.

The American Power Conference, sponsored by Illinois Institute of Technology in cooperation with 13 university and ten local and national engineering societies, of which The American Society of Mechanical Engineers is one, will be held on March 21–23, 1956, at the Sherman Hotel, Chicago, Ill.

The purpose of the conference is to provide a forum for the exchange of information in the fields of power generation, transmission, distribution, and utilization.

Registration information may be obtained from Dr. E. R. Whitehead, Secretary, American Power Conference, Illinois Institute of Technology, Chicago 16, Ill.

Sessions of particular interest to mechanical engineers have been selected from the preliminary program and are as follows:

WEDNESDAY, MARCH 21

9:00 a.m. — **Mezzanine Floor**

Registration

10:00 a.m. — **Grand Ballroom**

Opening Meeting

Chairman: *J. Harris Ward*, executive vice-president, Commonwealth Edison Co., Chicago, Ill.

Co-Chairman: *Donald H. Loughridge*, professor of engineering science, Northwestern University, Evanston, Ill.

Invocation

Power Makes the Difference. *R. S. Stevenson*, president, Allis-Chalmers Manufacturing Co., Milwaukee, Wis.

To be announced. *Hon. Clarence A. Davis*, Undersecretary of the Interior, Washington, D. C.

12:15 p.m. — **Bal Tabarin Room**

American Power Conference Luncheon

Sponsored by The American Society of Mechanical Engineers

Chairman: *Alex D. Bailey*, past-president and Hon. Mem. ASME

Co-Chairman: *J. N. Wognum*, chairman, Chicago Section, ASME, and chief research engineer, Acme Steel Company, Chicago.

Speaker: *Harllee Branch, Jr.*, president, Edison Electric Institute, and president, Georgia Power Company, Atlanta, Ga.

Subject: **The Electric Industry in This Year of Decision**

2:00 p.m. — **Grand Ballroom**

Central-Station Steam Generators

Chairman: *H. L. Solberg*, head, School of Mechanical Engineering, Purdue University, Lafayette, Ind.

Co-Chairman: *N. A. Hall*, assistant dean-in-charge, Graduate Division, New York University, New York, N. Y.

High-Capacity Two-Furnace Boilers. *E. M. Powell*, executive assistant to vice-president, Combustion Engineering, Inc., New York, N. Y.

Supercharged-Boiler Design Development and Application. *Ernest L. Daman*, deputy director of Research and Engineering, and *R. F. Zoschak*, project engineer, Foster Wheeler Corp., New York, N. Y.

2:00 p.m. — **Louis XVI Room**

Hydroelectric Power Development

Chairman: *Ben G. Elliott*, chairman, department of mechanical engineering, University of Wisconsin, Madison, Wis.

Co-Chairman: *R. L. Young*, assistant professor of mechanical engineering, Northwestern University, Evanston, Ill.

Underground Hydroelectric Stations in Brazil. *Adolph J. Ackerman*, consulting engineer, Madison, Wis.

The Wisconsin River—The Hardest Working River in the Nation. *M. W. Kyler*, vice-president and general manager, Wisconsin Valley Improvement Company, Wausau, Wis.

2:00 p.m. — **Assembly Room**

Gas-Turbine Power Plants

Chairman: *J. I. Yellott*, assistant director, Stanford Research Institute, Phoenix, Ariz.

Co-Chairman: *B. G. A. Skrotzki*, associate editor, *Power*, New York, N. Y.

Thermodynamic Performance and Design of Combined Steam-Gas-Turbine Power Plants. *J. W. Mann*, supervisor, special thermodynamic design engineering, medium steam turbine and gear department, General Electric Co., West Lynn, Mass.

Gas Turbines for Peak-Load Generation on a Large Utility System. *W. D. Marsh*, engineer, power generation engineering, and *C. M. Wright*, manager, electric utility and transportation sales, gas-turbine department, General Electric Co., Schenectady, N. Y.

3:30 p.m. — **Grand Ballroom**

Steam Generators—Removal and Disposal of Slag and Fly Ash

Sponsored by Power Group, Chicago Section, ASME

Chairman: *N. L. Markesich*, chairman, Power Group, Chicago Section, ASME, and boiler room engineer, Commonwealth Edison Co., Chicago.

Co-Chairman: *J. T. Anderson*, professor of mechanical engineering, Michigan State College, East Lansing, Mich.

Chemical Treatment for Fireside-Deposit Prevention in Coal-Fired Furnace. *Harris Thompson*, assistant vice-president, National Aluminate Corp., Chicago.

Fly Ash and Slag—Materials of Value. *R. B. Freston*, staff assistant to manager of production, Commonwealth Edison Co., Chicago

7:30 p.m. — **Grand Ballroom**

Nuclear-Energy Forum

Chairman: *Raymond D. Maxson*, senior vice-president, Commonwealth Edison Co., Chicago.

Co-Chairman: *Louis C. McCabe*, president, Resources Research, Inc., Washington, D. C.

An interesting program is being arranged to help keep engineers and executives in the power industry up to date on the latest developments in the field of nuclear energy for power production. A panel of four prominent speakers will participate, after which questions from the floor will be answered. The fields to be covered are:

(*a*) Role of Government in nuclear-power development.
(*b*) Role of industry in nuclear-power development.
(*c*) Research in nuclear power.
(*d*) Problems of insurance of nuclear power plants.

THURSDAY, MARCH 22

9:00 a.m. — **Grand Ballroom**

High-Temperature Metallurgical (*Session 1*)

Chairman: *S. T. Mackenzie*, sales manager, The Babcock & Wilcox Co., New York, N. Y.

Co-Chairman: *R. C. Porter*, professor of mechanical engineering, University of Michigan, Ann Arbor, Mich.

Thermodynamic and Economic Aspects of Supercritical-Pressure Turbine-Generator Units. *S. W. W. Mitchell*, design engineer, large turbine department, Steam Division, Westinghouse Electric Corp., Philadelphia, Pa.

Metallurgical Requirements of Metals for Steam Service Above 1000 F. *R. M. Wilson, Jr.*, head, Power Plant Development Section, and *Francis B. Foley*, consulting metallurgist, International Nickel Co., Inc., New York, N. Y.

Design Aspects of High-Pressure Feedwater Heaters. *J. M. West*, manager, Heater and Evaporator Department, Foster Wheeler Corp., New York, N. Y.

Central-Station Piping Trends. *Sabin Crocker*, mechanical engineer, and *Frank A. Ritchings*, chief mechanical engineer, Ebasco Service, Inc., New York, N. Y.

9:00 a.m. — **Louis XVI Room**

Water Technology (1)

Treatment of Feedwater in Industrial Power Plants

Chairman: *Charles J. Zeller, Jr.*, chairman, Engineers Society of Western Pennsylvania, and works engineer, Feeder and Service Division, Westinghouse Electric Corp., Pittsburgh, Pa.

Co-Chairman: *M. B. Golber*, head power plant engineer, Armour and Co., Chicago.

Coagulation—Key to Hot-Lime-Soda-Softener Operation. *Tom R. Day, Jr.*, assistant superintendent, utilities department, and *Allen W. Nonemaker*, Diamond Alkali Co., Painesville, Ohio

Steam Generation in a Cane-Sugar Refinery. *Gordon Lewis*, British Columbia Sugar Refining Co., Ltd., Vancouver, B. C., Can.

9:00 a.m. — **Assembly Room**

Fuels Session

Chairman: *Ed E. Williams*, vice-president, Duke Power Co., Charlotte, N. C.

Co-Chairman: *John E. Blair*, instructor in mechanical engineering, Illinois Institute of Technology, Chicago.

Effects of Preparation on the Economics of Coal Buying. *Julian E. Tobey*, president, Appalachian Coals, Inc., Cincinnati, Ohio

Impact of Freight Rates on the Distribution of Coal. *A. W. Vogtle*, vice-president, DeBartelebeu Coal Co., Birmingham, Ala.

The Breaking Point Between Coal, Oil, and Gas.

10:30 a.m. — **Louis XVI Room**

Water Technology (2)

Chairman: *Robert F. Andres*, vice-chairman, Chemistry Subcommittee, Prime-Movers Committee of Edison Electric Institute, and chief electrical engineer, Dayton Power and Light Co., Dayton, Ohio

Co-Chairman: *T. J. Hodan*, manager, Water Treatment Division, Allis-Chalmers Manufacturing Co., Milwaukee, Wis.

Chemistry of a Pressurized Nuclear-Power Plant. *James Seamon*, National Aluminate Corp., Chicago; *Paul Cohen*, manager, PWR Chemistry Section; and *Irving H. Welinsky*, SFR Process Development Section, Atomic Power Division, Westinghouse Electric Corp., Pittsburgh, Pa.

Ion-Exchange Membranes for Water Conditioning. *T. A. Kirkham*, director, Engineering Division, Ionics, Inc., Cambridge, Mass.

12:15 p.m. — **Bal Tabarin Room**

American Power Conference Luncheon

Sponsored by the American Institute of Electrical Engineers

Chairman: *M. D. Hooven*, president, American Institute of Electrical Engineers, and electrical engineer, Public Service Electric and Gas Co., Newark, N. J.

Co-Chairman: *R. B. Gear*, chairman, Chicago Section, AIEE, and director of purchases, Commonwealth Edison Co., Chicago.

Speaker: *Herbert D. Vogel*, chairman of the board, Tennessee Valley Authority, Knoxville, Tenn.

2:00 p.m. — **Grand Ballroom**

High-Temperature Metallurgical (*Session 2*)

Chairman: *A. A. Potter*, president, Bituminous Coal Research, Inc., and dean-emeritus of engineering, Purdue University, Lafayette, Ind.

Co-Chairman: *J. H. Harlow*, mechanical engineer, Philadelphia Electric Co., Philadelphia, Pa.

A Comparative Study of a Large Steam-Turbine Application for Supercritical and Conventional Pressures. *J. J. Fleischman*, engineer; *A. H. Gibling*, engineer, steam turbine department; *R. E. Lochen*, supervisor of physical metallurgy, Research Division; *A. Mergy*, supervisor of special projects, steam turbine department, Allis-Chalmers Manufacturing Co., Milwaukee, Wis.

Application of High-Temperature Metals to Modern Large Steam Turbines. *R. M. Curran* and *A. W. Rankin*, large steam turbine-generator department, General Electric Co., Schenectady, N. Y.

2:00 p.m. — **Louis XVI Room**

Water Technology (3)
Corrosion Symposium

Sponsored by the Joint Research Committee on Boiler Feedwater Studies.

Chairman: *P. B. Place*, vice-chairman, Joint Research Committee on Boiler Feedwater Stud-

ies, Research Department, Combustion Engineering, Inc., Chattanooga, Tenn.

Co-Chairman: *S. K. Adkins*, manager, Consulting Service, National Aluminate Corp., Chicago.

Corrosion Problems on Naval Vessels. *R. C. Adams*, chairman, Joint Research Committee on Boiler Feedwater Studies, U. S. Naval Experiment Station, Annapolis, Md.

Field Studies in Preboiler Corrosion of Utility-Type Systems. *H. A. Grabowski*, Combustion Engineering, Inc., New York, N. Y.

Cathodic Protection—Corrosion Control in Water. *L. D. Sudrabin*, The Electro-Rustproofing Co., Newark, N. J.

Corrosion Problems in Nuclear-Reactor Power Stations. *W. Z. Friend*, co-chairman, subcommittee on Reactor Corrosion Problems, Industrial Committee on Reactor Materials, Atomic Industrial Forum, Inc., International Nickel Co., New York, N. Y.

2:00 p.m. **Crystal Room**

Air Pollution

Chairman: *G. N. Hawley*, vice-president, Southern California Edison Co., Los Angeles, Calif.

Co-Chairman: *Martin A. Elliott*, professor of mechanical engineering, Illinois Institute of Technology, Chicago.

Significance of Sulphur Dioxide as an Air Contaminant. *Louis C. McCabe*, president, Resources Research, Inc., Washington, D. C.

Implications of Current Air-Pollution Legislation. *F. S. Mallette*, The American Society of Mechanical Engineers, New York, N. Y.

Air-Pollution Research. *W. L. Faith*, vice-president, Air Pollution Foundation, Los Angeles, Calif.

6:45 p.m. **Grand Ballroom**

All Engineers' Dinner

Entertainment: University of Wisconsin Glee Club, *Warren Wooldrige*, director.

Speaker: *J. T. Rettaliata*, president, Illinois Institute of Technology, Chicago.

FRIDAY, MARCH 23

9:00 a.m. **Grand Ballroom**

Industrial Power Plants

Chairman: *M. P. Cleghorn*, professor of mechanical engineering, Iowa State College, Ames, Iowa

Co-Chairman: *W. E. Ibele*, assistant professor of mechanical engineering, University of Minnesota, Minneapolis, Minn.

Some Features of a Recently Constructed Pulp-Mill Power Plant. *Edward J. Martin*, associate chief engineer, The Procter and Gamble Co., Cincinnati, Ohio

Linden Generating Station—A Large-Scale Exchange of Extraction Steam for Refinery Residual Fuel. *F. P. Fairchild*, chief engineer, electric-engineering department, Public Service Electric and Gas Co., Newark, N. J.

Experience With Centralized Control of a Three-Unit Boiler Installation. *G. F. Hoff*, in charge of instrument engineering; *Don Hagen*, chief steam and power engineer; and *L. C. Laird*, shop master mechanic, Corn Products Refining Co., Argo, Ill.

9:00 a.m. **Louis XVI Room**

Water Technology (4)

Steam Washers for Boilers and Performance of Demineralizing Equipment

Chairman: *Louis Wirth, Jr.*, chairman, Water Technology Division, Chicago Section, ASME, and special service engineer, Ion Exchange Division, National Aluminate Corp., Chicago.

Co-Chairman: *W. R. Homan*, chief chemist, Commonwealth Edison Co., Chicago.

Development of Steam Washers for Silica Removal. *Earl E. Coulter*, head, Engineering Physics Section, The Babcock & Wilcox Co., Alliance, Ohio

Full-Scale Tests and Operational Performance of Steam Washers. *Lester G. Friedle*, superintendent of control, power department, Dow Chemical Co., Midland, Mich.

Demineralization by Mixed-Bed Treatment at Waterside Station of Consolidated Edison Co., New York. *I. B. Dick*, assistant chief chemical engineer, Consolidated Edison Co. of New York, New York, N. Y.

Two-Years' Operation of a Two-Bed Demineralizing Plant With Gulf States Utilities. *W. B. Gurney*, superintendent of results, Gulf States Utilities, Baton Rouge, La.

Four professors from Michigan State University, East Lansing, were in Newton, Iowa, recently to pick out a Maytag subassembly operation and gather material about it for use in a new integrated sequence of engineering courses based on an actual industrial situation. Seated around the table with J. F. Biggane, Maytag chief industrial engineer, *second from left*, are Profs. Wayland P. Smith, Dale Jones, Jim Thorson, and Jim Apple, Mem. ASME, examining the automatic washer-clutch assembly, which they chose. The others, members of the Maytag industrial engineering staff which coordinated the educators' visit, are, *from left*, Wayne Creagan, supervisor of work simplification; Richard Burdick, P1 supervisor of incentives; Lavern Matson, P2 supervisor of incentives, and Lewis Oster, M-T-M engineer.

9:00 a.m. **Assembly Room**

Boiler Feed Pumps

Chairman: *H. L. Ross*, assistant manager, pump department, Allis-Chalmers Manufacturing Co., Milwaukee, Wis.

Co-Chairman: *Elmer C. Lundquist*, professor of mechanical engineering, State University of Iowa, Iowa City, Iowa.

Application of Single-Turbine-Driven Boiler-Feed Pump to 225,000-Kw Generating Units. *J. A. Tillinghast*, American Gas and Electric Service Corp., New York, N. Y.

Special Problems on Boiler Feed-Pump Installations. *L. J. Dawson*, engineer, Cameron Pump Division, Ingersoll Rand Co., Phillipsburg, N. J.

Economics of Turbine Drives for Boiler Feed Pumps. *A. G. Mellor*, senior engineer, Power Generation Engineering; *J. F. Ransom*, manager, Product Planning, General Electric Co., Schenectady, N. Y.; and *E. L. Pace*, engineer, small turbine and special discharger department, General Electric Co., Fitchburg, Mass.

12:15 p.m. **Bal Tabarin Room**

American Power Conference Luncheon

Sponsored by Western Society of Engineers

Chairman: *A. P. Boysen*, president, Western Society of Engineers, and district engineer, American Bridge Co., Chicago.

Co-Chairman: *F. D. Carvin*, chairman, department of mechanical engineering, Illinois Institute of Technology, Chicago.

Speaker: *John Jirgal*, chairman of Group on Power Generation and Distribution, Second Hoover Commission, and public-utility financial consultant, Chicago.

2:00 p.m. **Grand Ballroom**

Nuclear Power

Chairman: *J. C. Boyce*, vice-president of Academic Affairs and dean of the Graduate School, Illinois Institute of Technology, Chicago.

Co-Chairman: *Stuart McLain*, program coordinator, Argonne National Laboratory, Lemont, Ill.

Special Engineering Features in Design of the Experimental Boiling-Water Reactor Plant. *A. Kolflat*, senior partner, Sargent & Lundy, Engineers, Chicago.

Design Review of 10,000-Kw Boiling-Water Nuclear-Power Plant. *Howard Granis*, manager, Small Power Plants and Components Engineering, General Electric Co., Schenectady, N. Y.

President Barker to Speak at ASME Nuclear Power Plants Meeting, Pittsburgh, Pa.

Headquarters: Hotel William Penn April 30 and May 1, 1956

Joseph W. Barker, ASME President, will address members and guests at the banquet to be held during the annual mechanical-engineering conference of the Pittsburgh Section of The American Society of Mechanical Engineers. The two-day conference will be in session at the Hotel William Penn, April 30 and May 1. It was also announced that A. C. Pasini, Vice-President, Region V, will speak at the luncheon on the first day.

The theme of the conference will be "Nuclear-Energy Power Plants." Local engineers and scientists will present a comprehensive program. Papers will cover: Summary of power-reactor types, valves and specialties for nuclear-power plants, instruments as applied to such plants, and corrosion problems encountered in nuclear-power-plant operation. The program also includes discussion on zero-leakage pumping, starting procedures for nuclear plants, personnel training, safeguards, and remote-maintenance problems.

An inspection trip to the Duquesne Light Company nuclear-power project at Shippingsport, Pa., will conclude the meeting. Complete information on the meeting and program will be given in the April, 1956, issue of Mechanical Engineering.

Plant Visitations Important Part of Technical Program at 1956 ASME Spring Meeting, in Portland, Ore., March 18–21

In addition to the 16 technical sessions planned for the 1956 Spring Meeting of The American Society of Mechanical Engineers, which will be held at the Multnomah Hotel, Portland, Ore., a choice of several field trips is offered. Most of the trips are being conducted at different times to enable everyone the opportunity to attend any or all.

For the best accommodations it is suggested that anyone interested in participating in any of the following trips should make his reservation as early as possible before leaving for Portland.

Hyster Company Trip, Monday, 7:00 p.m. The Hyster Company manufactures material-handling, logging, and construction equipment for world-wide distribution. All departments of this modern factory will be in full operation during the evening visit of ASME. Such products as fork-lift trucks, straddle trucks, tractor winches, and a variety of contractors' equipment will be demonstrated.

Crown Zellerbach Paper Mill, Camas, Wash., Wednesday, 1:00 p.m. At this completely integrated mill the entire process of paper manufacture and fabrication from the logs to finished products can be viewed. From the log barker to the bag plant or the napkin factory this mill is modern in every respect. Dinner will be available at a fine old inn before returning to Portland.

Mount Hood, Wednesday, 1:00 p.m. This trip has been arranged for those who enjoy scenery and wish to relax high up the slope of the mountain. Ample time will be given to play in the snow before dinner at the well-known Timberline Lodge.

Columbia River Hydropower Trip, Thursday, 9:00 a.m. This is an all-day trip up the beautiful Columbia River on the new water-level highway. First stop will be at the 600-ft Multnomah Falls (bring your camera). Next stop will be at Bonneville Dam for a quick look at the 10-unit 600,000-kw powerhouse. Lunch will be at the old pioneer town of The Dallas. The afternoon will be spent viewing The Dallas Dam which is really a large hydropower project in its fourth year of construction.

Weyerhaeuser Timber Company, Longview, Wash., Thursday, 9:00 a.m. This is a chance to see trees converted into a long list of forest products. In addition to lumber, plywood, and pulp this plant supplies raw material in the form of fibers and wood chemicals to producers of nearly 4000 items in every-day use. Longview is an outstanding example of a planned city that owes its existence to the production of forest products. Lunch will be available for those making the trip.

Women's Program

Several events are planned for the women who attend the 1956 Spring Meeting. On Monday, March 19, a trip is scheduled to the Art Museum where the Walter P. Chrysler, Jr., collection of paintings will be viewed. This collection includes 101 selected paintings from the works of sixteenth to twentieth-century artists including Rubens, Rembrandt, Goya, Gainsborough, Van Dyck, and many others. This is a world-premier showing and will only be shown in eight other states.

An all-day program is planned for Tuesday, March 20, starting at 9:30 a.m. with a trip to the Jantzen Knitting Mills, world-famous for swim suits, sweaters, skirts, and so on. At noon, a luncheon and tour are planned at the Kamm House. The tour will include inspection of some early residences of Portland which now include a restaurant and shops. The homes have been reconstructed and are open for inspection showing the beautiful and lavish woodwork used for decorative purposes in early Portland homes.

On Wednesday, March 21, the women will join the group taking the trip to Mount Hood.

Thermal Thicket and Air-Cargo Themes Mark ASME Aviation Conference

The Aviation Division Conference of The American Society of Mechanical Engineers will develop two general themes, "Thorns in The Thermal Thicket" and "Air Cargo and Air Logistics—Today and Tomorrow." The Conference is the result of pooled efforts of the ASME Aviation Division, ASME Instruments and Regulators Division, American Rocket Society, and Institute of the Aeronautical Sciences. It is scheduled to be held at the Hotel Statler, Los Angeles, Calif., March 14–16, 1956.

In addition to the technical sessions previously announced, a luncheon has been planned for Wednesday, March 14, with Major General Roy H. Lynn, Commander of the Western Air Defense Force, as a speaker. His subject will be "Engineering and Air Defense."

A luncheon also has been planned for Thursday, March 15, and will feature a panel composed of chief test pilots from various aircraft companies speaking on the subject "What I Want Most From The Engineer."

The Hon. C. C. Furnas, Mem. ASME, Assistant Secretary of Defense for Research and Development and former Chancellor of The University of Buffalo, will be the main speaker. Joseph W. Barker, ASME President, will preside.

Field Trips

Two field trips are offered on Friday, March 16. The Long Beach Plant of the Douglas Aircraft Company will be visited. The trip will include inspection of the C-133 Cargo Line as well as a tour through the areas of the plant which house the major jigs and the assembly line for this cargo aircraft.

The Thermal-Biotechnology Laboratory of the University of California at Los Angeles will also be visited on Friday, March 16. Dean L. M. K. Boelter of the Engineering School, will be on hand for a planned program which will include a briefing, a tour of the facilities, and a discussion.

Women's Program

The high light of the women's program is an all-day trip on Friday, March 16, to Disneyland. This trip will include lunch at the Red Wagon Inn and a complete tour of the grounds and the attractions which have obtained world-wide fame.

Further Details on the Fourth ASME Engineering Management Conference Announced

The fourth annual Engineering Management Conference of the Management Division of The American Society of Mechanical Engineers will be held in the Hotel Statler, St. Louis, Mo., March 14–15, 1956. The program has been developed around the theme "Improving Management With and for Engineers." In addition to the four technical sessions previously announced, two luncheons and a banquet offer interesting programs. The luncheon on the first day, March 14, will feature Lillian M. Gilbreth, Hon. Mem. ASME, as the principal speaker. Dr. Gilbreth and her late husband are known the world over for their work in developing techniques in the field of motion study and in applying engineering to the humanities.

The banquet on Wednesday evening, March 14, will have Albert C. Hall, general manager of the Research Division of Bendix Aviation Corp., as speaker. Dr. Hall was a member of the three-man ASME delegation who recently visited several industrial plants in the USSR.

The main luncheon speaker on Thursday, March 15, will be Leonard J. Fletcher, vice-president of the Caterpillar Tractor Company.

U. K. Atomic Energy Authority Lists Available Publications

The United Kingdom Atomic Energy Authority recently released List No. 1, dated December, 1955, of publications available to the public. The list was compiled by the Library, Atomic Energy Research Establishment, Harwell, Didcot, Berkshire, England.

Included in the list are original documents and translations issued by the Atomic Energy Research Establishment and the Industrial Group of the U.K. AEA, together with articles in periodicals contributed by the Authority's staff.

Documents are deposited in the U.K. AEA depository libraries as well as in the Copyright Libraries and in the Patent Office Library.

Some of the documents may be purchased from Her Majesty's Stationery Office. Depository libraries are: Science Museum Library, South Kensington, London, S.W. 7; Central Library, Ratcliff Place, Birmingham, 1; The Mitchell Library, North Street, Glasgow, C.3; and the Central Library in Liverpool, Manchester, Newcastle-upon-Tyne, and Sheffield.

Second ASME Instruments and Regulators Division Conference to Be Held at Princeton University

THE Instruments and Regulators Division of The American Society of Mechanical Engineers will hold its second annual conference at Princeton University, Princeton, N. J., March 26 through 28. The three-day conference on "Control Systems" is cosponsored by the Feedback Control Systems Committee of the American Institute of Electrical Engineers.

The technical papers to be presented, developing the theme, will be on basic and new methods for analysis of nonlinear control systems, practical systems with inherent nonlinearities, theoretical and computer studies of so-called optimum relay servomechanisms, and synthesis methods for nonlinear systems.

The tentative program follows:

MONDAY, MARCH 26

8:00 a.m. — **Princeton Inn**

Authors' Breakfast

8:30 a.m. — **Frick Lobby**

Registration

9:30 a.m. — **Frick Auditorium**

Technical Session 1

Chairman: *W. I. Caldwell*, Taylor Instrument Companies, Rochester, N. Y.

Vice-Chairman: *W. D. Archibald*, Energy Control Co., New York, N. Y.

Nonlinear Phenomena, by *Carl A. Ludeke*, University of Cincinnati, Cincinnati, Ohio

Effects of Nonlinearities in Multiloop Lead-Angle Prediction Systems, by *A. A. Clark* and *H. J. Pixley*, General Electric Co., Schenectady, N. Y.

A Résumé of the Development and the Literature of Nonlinear Control Theory, by *Thomas J. Higgins*, University of Wisconsin, Madison, Wis. (Paper No. 56—IRD–4)

12:30 p.m. — **Chancellor Green Student Center**

Luncheon

2:30 p.m. — **Frick Auditorium**

Technical Session 2

Chairman: *A. R. Aikman*, Schlumberger Instrument Co., Ridgefield, Conn.

Vice-Chairman: *W. E. Karg*, Public Service Electric & Gas Co., Burlington, N. J.

Electrohydraulic Servomechanism With an Ultrahigh Frequency Response, by *D. P. Eckman, C. K. Tafi,* and *R. L. Schman*, Case Institute of Technology, Cleveland, Ohio (Paper No. 56—IRD–8)

Nonlinear Analog Study of a High-Pressure Pneumatic Servomechanism, by *J. L. Shearer*, Massachusetts Institute of Technology, Cambridge, Mass. (Paper No. 56—IRD–1)

A Dual-Mode Damper-Stabilized Servo, by *J. Jursik*, Clevite-Brush Development Co., Cleveland, Ohio; *J. F. Kaiser*, and *J. E. Ward*, Massachusetts Institute of Technology, Cambridge, Mass. (Paper No. 56—IRD–6)

Experiments With Optimalizing Controls Applied to Rapid Control of Fluid Pressure With High-Amplitude Noise Signal, by *George Vasu*, Lewis Flight Propulsion Laboratory, NACA, Cleveland, Ohio

Representation of Nonlinear Functions of Two Input Variables on Analog Equipment, by *D. A. Elliott*, Curtiss-Wright Corp., Caldwell, N. J.

TUESDAY, MARCH 27

8:00 a.m. — **Princeton Inn**

Authors' Breakfast

8:30 a.m. — **Frick Lobby**

Registration

9:30 a.m. — **Frick Auditorium**

Technical Session 3

Chairman: *Ralph Kochenburger*, University of Connecticut, Storrs, Conn.

Vice-Chairman: *W. H. Surber, Jr.*, Princeton University, Princeton, N. J.

Basic Methods for Nonlinear Control-System Analysis, by *T. M. Stout*, Schlumberger Instrument Co., Ridgefield, Conn. (Paper No. 56—IRD–9)

Describing Functions Representing the Effect of Inertia, Backlash, and Coulomb Friction on Stability, by *K. N. Satyendra*, Air Arm Division, Westinghouse Electric Corp., Baltimore, Md.

How to Obtain Equivalent Transfer Functions (Describing Functions) for Nonlinear Feedback Systems, by *K. Klotter*, Stanford University, Stanford, Calif. (Paper No. 56—IRD–5)

Design of Contractor Servo Using Describing-Function Theory, by *S. K. Chao*, Atomic Instrument Co., Cambridge, Mass.

12:30 p.m. — **Chancellor Green Student Center**

Luncheon

2:30 p.m. — **Frick Auditorium**

Technical Session 4

Chairman: *Harold Chestnut*, General Electric Co., Schenectady, N. Y.

Vice-Chairman: *J. M. Mosley*, E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.

The Frequency Response of a Servomechanism Designed for Optimum Response, by *J. C. West* and *P. N. Nikiforuk*, University of Manchester, Manchester, England.

Design and Analog-Computer Analysis of an Optimum Third-Order Nonlinear Servomechanism, by *H. G. Doll* and *T. M. Stout*, Schlumberger Instrument Co., Ridgefield, Conn. (Paper No. 56—IRD–10)

Optimum Nonlinear Control, by *Rufus Oldenburger*, Woodward Governor Company, Rockford, Ill.

A Phase-Space Method for the Synthesis of Nonlinear Servomechanism, by *Richard E. Kuba*, Wayne University, Detroit, Mich., and *Louis F. Kazda*, University of Michigan, Ann Arbor, Mich.

6:15 p.m. — **Princeton Inn**

Social Hour

Courtesy of Philadelphia Section ASME and AIEE

7:00 p.m. — **Princeton Inn**

Banquet

Speaker: *Frank W. Notestein*, director, Office of Populations Research, School of Public and International Affairs, Princeton University

Subject: **The Dynamics of Populations.**

WEDNESDAY, MARCH 28

8:00 a.m. — **Princeton Inn**

Authors' Breakfast

8:30 a.m. — **Frick Lobby**

Registration

9:30 a.m. — **Frick Auditorium**

Technical Session 5

Chairman: *Ernest F. Johnson*, Princeton University, Princeton, N. J.

Vice-Chairman: *E. G. Holzmann*, Shell Development Co., Emeryville, Calif.

On the Analysis of Linear and Nonlinear Systems, by *Marvin Shinbrot*, Ames Aeronautical Laboratory, NACA Moffett Field, Calif. (Paper No. 56—IRD–2)

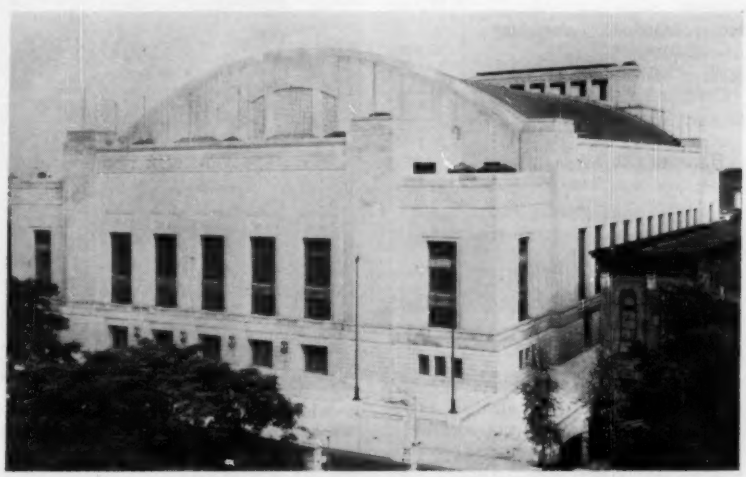
Physical and Mathematical Mechanisms of Instability in Nonlinear Automatic-Control Systems, by *R. E. Kalman*, Columbia University, New York, N. Y.

Determination of the Characteristics of Multi-Input and Nonlinear Systems From Normal Operating Records, by *T. F. Goodman*, Massachusetts Institute of Technology, Cambridge, Mass.

Spectral Response of Control Systems Containing Zero-Memory Nonlinearity to Random Inputs, by *Yoshikazu Sawaragi*, Kyoto University, and *Seiuo Takahashi*, Kyoto Technical College, Kyoto, Japan.

12:30 p.m. — **Chancellor Green Student Center**

Luncheon



The Machine Design Division of The American Society of Mechanical Engineers will sponsor a conference on design engineering at the first Design Engineering Show, to be held at Convention Hall, *above,* Philadelphia, Pa., May 14–17. The theme of the show is "Tomorrow's Products Are Tomorrow's Markets." Conference topics include cost reduction in product design, finding and training men for the design-engineering field, selection of engineering materials, the effect of miniaturization upon design, compensating employees for inventions, and the rights of a company employee in inventions he develops.

2:30 p.m.

Technical Session 6

Chairman: *Mead Bradner*, The Foxboro Company, Foxboro, Mass.

Vice-Chairman: *W. E. Reaser*, Princeton University, Princeton, N. J.

Hunting Due to Lost Motion, by *H. Poritsky*, General Electric Company, Schenectady, N. Y.

Comparison of Backlash and Hysteresis Effects in Autonomous Second-Order Feedback Systems, by *L. M. Vallese*, Polytechnic Institute of Brooklyn, Brooklyn, N. Y.

Nonlinear Integral Compensation of a Velocity-Lag Servomechanism With Backlash, by *C. N. Shen*, Dartmouth College, Hanover, N. H.; *H. A. Miller*, and *N. B. Nichols*, Raytheon Manufacturing Co., Waltham, Mass. (Paper No. 56—IRD–3)

Women's Program

Ladies' Headquarters
Engineering Lounge, Washington Rd.

SUNDAY MARCH 25

4:00–7:00 p.m.: **Early-Bird Tea For All Conferees and Wives**

MONDAY, MARCH 26

3:00 p.m.: **Tour of Campus**

TUESDAY, MARCH 27

3:00 p.m.: **Bridge**
6:15 p.m.: **Special Hour**
7:00 p.m.: **Banquet**

Committee Meetings

Committee meetings to be held in conjunction with the 1956 symposium are scheduled as follows:

Sunday, March 25, Executive Committee	10:00 a.m.
Sunday, March 25, Executive and Advisory Committees	2:00 p.m.
Sunday, March 25, Application Committee	10:00 a.m.
Sunday, March 25, Design Committee	4:30 p.m.
Sunday, March 25, Terminology Committee	7:30 p.m.
Sunday, March 25, Education Committee	8:30 p.m.
Monday, March 26, Theory Committee	7:30 p.m.
Monday, March 26, Long-Range Planning	8:30 p.m.

Coming Meetings

Aircraft Exhibit

An exhibit of the latest airborne electrical apparatus, components, and auxiliary equipment will be a feature of the Southwest District Meeting of the American Institute of Electrical Engineers in the Baker Hotel, Dallas, Texas, April 2–4. The theme of the meeting is "Electricity in Aircraft."

Plans are being made for 60 exhibit booths and most of the major aircraft companies in the district will participate.

The District comprises the states of Texas, New Mexico, Oklahoma, Kansas, Missouri, Arkansas, and part of Louisiana, and is one of the major aircraft-producing areas in the country.

Science Fair

Plans for the third annual Greater Newark Science Fair to be held at Newark College of Engineering, Newark, N. J., April 13 and 14, were announced.

A total of 131 public, private, and parochial junior and senior high schools in the five counties of Essex, Union, Hudson, Morris, and Passaic, plan to exhibit at the Fair, with a predicted increase by the Committee of as many as fifty exhibits over the 165 shown last year.

Students will display their projects, the result usually of five months' work, at the college's Laboratory Building, 367 High Street, Newark, before a special judging committee on Friday, April 13. The Fair, including winning displays, will be open to the public on Saturday.

The 1956 Fair will offer exhibitors an opportunity to win one of the two top awards on the local level which will make possible a chance to compete in the 7th National Science Fair, May 10 to 12, at Oklahoma City, Okla. National winners not only will receive awards of scientific equipment, but are in an excellent position to obtain fully paid scholarships granted by leading colleges and universities.

The Science Fairs were originally instituted as a means of providing opportunities for scientifically minded students to develop their abilities under competitive conditions in order to attract as many as possible to thinking of science as a career.

Meetings of Other Societies

March 15–16
American Institute of Industrial Engineers, fifth annual spring conference, Hotel Cleveland, Cleveland, Ohio

March 19–21
Society of Automotive Engineers, national production meeting and forum, Hotel Statler, Cleveland, Ohio

March 19–22
Institute of Radio Engineers, national convention and radio-engineering show, Waldorf-Astoria Hotel and Kingsbridge Armory, New York, N. Y.

March 19–23
American Society of Tool Engineers, 24th annual convention and exposition, International Amphitheatre, Chicago, Ill.

March 25–29
American Society for Metals, tenth Western Metal Exposition and Congress, Pan-Pacific Auditorium and Ambassador Hotel, Los Angeles, Calif.

April 4–6
American Society of Lubrication Engineers, 11th annual meeting and exhibit, William Penn Hotel, Pittsburgh, Pa.

April 4–7
National Screw Machine Products Association, annual meeting, Hotel Schroeder, Milwaukee, Wis.

April 9–12
American Management Association, Silver Anniversary packaging exposition and conference, Convention Hall, Atlantic City, N. J.

April 9–13
The Institution of Electrical Engineers, convention on digital computer techniques, Institution Building, London, England

(*ASME Coming Events, see page 285*)

Lockheed Aircraft Corporation Missile Systems Division officials announced that two new research laboratories will be built on a 22½-acre site adjacent to Stanford University's campus at Palo Alto, Calif. Louis N. Ridenour, *center*, Lockheed scientist who directs the missile division's research program, indicates site of the research buildings during discussions with Frederick E. Terman, *right*, university provost and dean of the Stanford School of Engineering, and Dwight B. Adams, assistant business manager for the University. Construction will begin immediately on the two new laboratory buildings, which will contain 102,000 sq ft of floor space devoted to advanced research work in the complex field of missile-systems engineering. Lockheed also plans missile-production facilities at Sunnyvale, Calif. These new facilities are first steps in a research and development program calling for a Lockheed investment of approximately $20 million in the next three years.

28th ASME Oil and Gas Power Conference and Exhibit to Be Held in New Orleans, La.

Headquarters: Jung Hotel, April 2–5

THE 28th annual conference and exhibit of the Oil and Gas Power Division of The American Society of Mechanical Engineers will be held in the Jung Hotel, New Orleans, La., April 2 through 5. The Division has pitched this year's conference to the theme "Marine and Pipe-Line Oil and Gas Power" in an effort to be of service to nearby oil-field and pipe-line operating personnel as well as the Gulf of Mexico and inland-waterways marine interests.

The technical program will be presented in seven sessions. Panels are scheduled dealing with applications and performances of torque converters and fluid coupling and marine-engine maintenance.

Exhibits presently booked cover a wide range of engines, parts, accessories, and services. Ample time has been provided in the program for inspection of the exhibits, a most interesting and instructive feature of the meeting. Several inspection trips are planned, including a shipyard engaged in construction of offshore drilling and river-towboat equipment. Social periods during the week are designed to bring both old and new friends together.

Recent years have seen steadily increasing importance and popularity of these OGP conferences. Attendance records have been broken year after year. The New Orleans meeting is expected to continue this trend. Exceptional tourist attractions in this area have enabled the host ASME Section, New Orleans, to arrange an exciting program for the women—an outstanding opportunity for the wives of the conferees to enjoy a real outing.

The tentative program follows:

SUNDAY, APRIL 1, 1956

12:00 noon
Registration

5:00 p.m.
OGP Executive Committee Meeting

MONDAY, APRIL 2, 1956

8:00 a.m.
Authors' Breakfast

9:00 a.m.
Registration

9:00 a.m. — **Exhibits Area**
Exhibits Open

9:30 a.m.
Technical Session 1

Chairman: *T. O. Kuivinen*, Cooper-Bessemer Corp.

Vice-Chairman: *K. W. Stinson*, Ohio State University

Rating Engines by Fuel-Air Ratio Effects, by *Robert Cramer, Jr.*, and *Kurt Froehlich*, Nordberg Manufacturing Co.

The Measurement of Engine Response to Sudden Load Change, by *L. T. Brinson, Jr.*, and *Edwin Schuster*, Nordberg Manufacturing Co.

11:45 a.m. — **Exhibit Area**
Exhibitors' Social Hour
(Ladies invited)

12:30 a.m. — **(Ladies welcome)**
Welcome Luncheon

2:00 p.m.
Technical Session 2

Panel Moderator: *John Pennington*, Koppers Co., Inc.

Vice-Chairman: *Wilbur W. Young*, Diesel Publications, Inc.

Panel Discussion: **Torque Converters and Fluid Couplings—Their Application and Performance.**

Panel Members: *H. N. Roberts*, Allison Transmission Operation, General Motors Corp.
Ben Ragland, Fluid Drive Division, American Blower Division, American Radiator and Standard Sanitary Corp.
Wayne Howard, Transmission Division, Clark Equipment Company
James Glidden, National Supply Company
Wilton B. Gibson, Hydraulic Division, Twin Disc Clutch Company

TUESDAY, APRIL 3, 1956

8:00 a.m.
Authors' Breakfast

9:00 a.m.
Registration

9:00 a.m. to 12:00 noon — **Exhibit Area**
Exhibits Open

9:30 a.m.
Technical Session 3

Chairman: *W. M. Kauffmann*, Engine Division, Worthington Corporation

Vice-Chairman: *Brian Corrigan*, Technical and Research Div., The Texas Company

Recent Developments in Gas-Engine Ignition, by *R. B. Clark*, Scintilla Division, Bendix Aviation Corporation

A Combustion System for Spark-Fired Gas Engines Using Diesel Compression Ratios, by *L. D. Thompson, F. A. Blake*, and *R. H. Beadle*, Experimental Department, Fairbanks, Morse & Company

1:30 p.m.
Inspection Trip

Inspection trip to a shipyard engaged in construction of offshore drilling or river-towboat equipment.

WEDNESDAY, APRIL 4, 1956

8:00 a.m.
Authors' Breakfast

9:00 a.m.
Registration

9:00 a.m. — **Exhibit Area**
Exhibits Open

9:30 a.m.
Technical Session 4

Chairman: *D. Roger Needl*, Heavy Machine Division, Nordberg Manufacturing Company

Vice-Chairman: *C. P. Keller*, Commissioner of Public Utilities, Rockville Center, L. I., N. Y.

Maintenance Practices in a Large Internal-Combustion-Engine Power Plant, by *Howard Keefer*, Point Comfort Works, Aluminum Company of America

Experiences With Aluminum Bearings in Heavy-Duty Engines and Compressors, by *J. P. Hyde*, Ingersoll-Rand Co.

2:00 p.m.
Technical Session 5

Chairman: *Thomas Pofahl*, El Paso Natural Gas Co.

Vice-Chairman: *O. H. Moore*, Tennessee Gas Transmission Co.

Automatic Operation of Gas-Engine Pipe-Line Compressor Stations, by *David M. Salls* and *Edgar N. Sampson*, Cooper-Bessemer Corp.

Power for Petroleum, a special lecture by *J. P. Martin*, The Texas Company

5:30 p.m. — **Exhibit Area**
Exhibitors' Social Hour
(Ladies invited)

6:30 p.m. — **(By invitation only)**
Reception for Honored Guests

7:00 p.m. — **(Ladies invited)**
Dinner—Informal Dress

THURSDAY, APRIL 5, 1956

8:00 a.m.
Authors' Breakfast

9:00 a.m.
Registration

9:00 a.m. — **Exhibit Area**
Exhibit Open

9:30 a.m.
Technical Session 6

Chairman: *Gale H. Chapman*, Upper Mississippi Towing Co.

Vice-Chairman: *J. C. Gibb*, Socony Mobile Oil Co., Inc.

The Performance of Controllable Pitch Propellers in River-Towboat Operation, by *Captain Ralph F. Clark*, Northern Division, Lake Tankers Corp.

Heavy Fuel and Cylinder Wear in Marine Diesel Engines, by *J. M. A. (Hans) Van der Horst*, Van der Horst Corporation of America

11:45 a.m. — **Exhibit Area**
Exhibitors' Social Hour
(Ladies invited)

2:00 p.m.
Technical Session 7

Panel Moderator: *William J. Fritton*, Van der Horst Corp.

Vice-Chairman: *Dwight McMakin*, American Airfilter Co.

Panel Discussion: **Marine-Engine Maintenance**

Panel Members: *A. C. Grammer*, Lake Tankers Corp.
Pat J. Breen, Commercial Transport Corp.
James E. Moran, Mississippi Shipping Co.
John G. Stocker, Cleveland Diesel Division, General Motors Corp.
William T. Malone, Cooper-Bessemer Corp.
George Schauer, Fairbanks, Morse & Co.

5:30 p.m.
OGP Executive Committee Meeting

1957 Conference
Kentucky Hotel, Louisville, Ky.

Jess H. Davis Urges American Leadership in Engineering

AMERICAN industry must have engineers with "greater breadth of view" and "adaptability" if it is to retain its leadership over Soviet Russia which is now producing twice as many engineering graduates as this country. To do so, American engineering colleges will have to concentrate on teaching engineering science and let industry handle the "how-to-do-it" technical instruction now done largely by the colleges.

These views were expressed by Jess H. Davis,

Mem. ASME, president of Stevens Institute of Technology, at the engineering college's annual alumni dinner at the Hotel Sheraton-Astor attended by 600.

In delivering the principal address, Dr. Davis noted that Soviet Russia had graduated 53,000 engineers last year as against 22,500 in the United States. He also pointed out that the Russian engineers were trained in highly specialized types of engineering work and the specialization, he said, creates an opportunity for the United States to counter "this potential threat to our security and to our industrial leadership" by broadening the viewpoint of the American engineering student.

"Specialization is an integral part of industrialization," Dr. Davis said. "But if we hope to keep our free, industrial society supreme, all our engineers and scientists must be men with the breadth of view and the adaptability to make use of engineering knowledge in all fields instead of a tiny corner of a single field."

He cited the overlapping of scientific fields like biochemistry, biophysics, and physical chemistry as examples of "how the fences are disappearing in science as we come to recognize the universality of scientific truths."

Engineer of the Future

"The engineering leader of the future," Dr. Davis said, "must also be at home in many branches of his calling if he hopes to reap the benefits the new scientific and engineering concepts make possible. The century ahead in science and in engineering belongs not to the specialist, but rather to the synthesist who can fit together many disparate truths and create a new truth."

To bring this about, the Stevens president advocated fewer how-to-do-it courses in engineering colleges and more courses in mathematics and the engineering sciences.

"If we are to keep ahead of the world, there must be fewer engineering vocational schools and more engineering academics," he said.

If American industry is to "keep ahead of the Soviets and their overspecialized technologists," Dr. Davis added, "it must have engineers who combine with their 'know-how' a 'know-why'—a broader, deeper knowledge of the laws of science and how to use them."

Industry's Job

Industry is already doing "a much better job than the colleges" in teaching new graduates practical engineering techniques connected with their immediate work assignments, Dr. Davis said.

He further predicted, "Eventually industry will teach a major portion of the engineering applications of science, leaving it to the engineering colleges to concentrate on improving the undergraduate's understanding of the theoretical concepts on which the applications are based."

First ASME Gas Turbine Power Conference Scheduled in Washington, D. C., April 15–18

THE nation's capital has been selected as the site for the first conference of the Gas Turbine Power Division of The American Society of Mechanical Engineers. The conference and exhibit are scheduled for April 15 to 18 at the Hotel Statler in Washington, D. C.

Approximately 500 engineers, scientists, and industrial leaders from both Europe and the United States will meet for the three-day conference. The program will include six sessions covering the fields of industrial power, marine, and aviation applications of the gas-turbine prime mover.

Recent work on rotary heat exchangers with the attendant improvements in gas-turbine-cycle efficiencies will be included. Another high light of the program will be an inspection trip to the Naval gun factory for a demonstration of some of the applications in use for the Army, Navy, and Air Force, including mobile gas-turbine generators, gas-turbine fire pumps, gas-turbine locomotives, and gas-turbine-driven launches. No jet engines will be shown at this exhibit.

Many major manufacturers plan to have gas turbines, gas-turbine components, and associate equipment on display at the Statler.

Washington was considered to be a good location for the conference because of the growing interest of governmental agencies in this field. Chairman of the ASME Washington Section, host to the conference, is John W. Sawyer of the Gas Turbine Branch, Bureau of Ships, Navy Department.

The tentative program follows:

SUNDAY, APRIL 15

12:00 noon — **Mezzanine**

Registration

5:00 p.m. — **Ohio Room**

GTP Executive Committee Meeting

8:00 p.m. — **Ohio Room**

Marine Committee of GTP Meeting

MONDAY, APRIL 16

8:00 a.m. — **Ohio Room**

Authors' Breakfast

9:00 a.m.–5:00 p.m. — **Mezzanine**

Registration

8:30 a.m.–6:00 p.m. — **Exhibit Area**

Exhibit Open

9:30 a.m. — **Presidential Ballroom**

Official Opening of the First Annual Gas Turbine Power Division Conference and Exhibit by Frank L. Schwartz, chairman, GTPD.

9:45 a.m.

Combustion—Technical Session 1

Chairman: *H. R. Hazard*, Battelle Memorial Institute

Vice-Chairman: *Stewart Way*, Westinghouse Electric Corp.

Increased Life for Residual Fuel-Burning Gas-Turbine Combustion Systems, by R. W. *MacAulay* and *C. M. Gardiner*, General Electric Co.

Effect of Ambient and Fuel Pressure on Nozzle-Spray Angle, by *G. A. Kemeny* and *S. M. DeCorso*, Westinghouse Electric Corp.

An Experimental Arrangement for the Measurement of the Pressure Distribution on High-Speed Rotating-Blade Rows, by *K. Leist*, Technical University, Aachen, Germany

2:00 p.m. — **Presidential Ballroom**

Transportation and Industrial—Technical Session 2

Chairman: *A. A. Hafer*, General Electric Co.

Vice-Chairman: *F. O. Hennig*, Clark Brothers Co.

Gas Turbine for Mobile Power Unit, by *F. O. Hennig*, Clark Brothers Co.

6200-Kw Gas-Turbine-Driven Mobile Power Plant, by *Z. Stanley Slys*, Brown Boveri Corp.

El Paso's Gas-Turbine Operating Experience, by *A. H. Carameros*, El Paso Natural Gas Co.

8:00 p.m. — **Presidential Ballroom**

Aviation—Technical Session 3

Chairman: *S. D. Hage*, Boeing Airplane Co.

Vice-Chairman: *Charles T. Miller*, Bureau of Aeronautics

Development of the Allison Turboprop Engine, by *G. E. Holbrook*, Allison Division, General Motors Corp.

Development of a Centrifugal Compressor for a Small Gas-Turbine Engine, by *N. R. Balling* and *V. W. Van Ornum*, Boeing Airplane Co.

A New Gas-Turbine-Drive Auxiliary Power Plant, by *Ralph Kress*, Solar Aircraft Co.

TUESDAY, APRIL 17

8:00 a.m. — **Ohio Room**

Authors' Breakfast

9:00 a.m. — **Mezzanine**

Registration

8:30 a.m.–6:00 p.m. — **Exhibit Area**

Exhibit

9:30 a.m. — **Presidential Ballroom**

Nuclear Power and Closed Cycles—Technical Session 4

Chairman: *L. N. Rowley, Jr.*, McGraw-Hill Publishing Co., Inc.

Vice-Chairman: *M. A. Mayers*, Burns & Roe, Inc.

Operating Experiences and Design Features of Closed-Cycle Gas Turbines, by *C. Keller*, Escher-Wyss, Switzerland

Internally Fired Closed-Cycle Turbines, by *W. B. Boyum*, Westinghouse Electric Corp.

Nuclear-Powered Gas Turbines, by *C. Keller*, Escher-Wyss, Switzerland

1:00 p.m.–4:00 p.m.

Inspection Trip

Department of Defense Gas Turbine Exhibit, U. S. Naval Gun Factory, Washington, D. C. Bus transporation will be provided.

6:00 p.m. — **Congressional Room Ladies invited**

Cocktail Hour

7:00 p.m. — **Presidential Ballroom**

Dinner

Introductions: *Frank Schwartz*, chairman, ASME Gas Turbine Power Division

Remarks by: *J. W. Barker*, ASME President

Speaker: *Clifford C. Furnas*, Assistant Secretary of Defense for Research and Development

Presentation of Awards

WEDNESDAY, APRIL 18

8:00 a.m. — **Ohio Room**

Authors' Breakfast

9:00 a.m.–2:00 p.m. — **Mezzanine**

Registration

Edmund R. Purves, executive director, American Institute of Architects, Washington, D. C., addressing the Northwest Regional Council, Glacier Park, Mont., on "Our Profession—Its Place in America's Future," lauded ASME. "Then there is The American Society of Mechanical Engineers, which is possibly the greatest technological force in the whole economy. Its members include those with whom we are associated in construction, plus the whole area of transportation, power, and light. It is they who are looked up to more than any other group in the United States, for they are responsible for our transportation, our recreation, and our mechanical comfort," he said.

8:30 a.m.–3:00 p.m. — **Exhibit Area**

Exhibit

9:30 a.m. — **Presidential Ballroom**

Marine—Technical Session 5

Chairman: *D. A. Holden*, Newport News Shipbuilding Co.

Vice-Chairman: *T. J. Puts*, Westinghouse Electric Corp.

33,000 Hours on Marine Gas Turbines in Naval Vessels, by *W. M. M. Fowden, Jr.*, and *J. W. Sawyer*, Gas Turbine Branch, Bureau of Ships, Department of the Navy

Design Considerations for Naval Gas Turbines, by *G. L. Graves*, Bureau of Ships, Department of the Navy

Sleeve-Bearing Development for High-Speed Gas-Turbine Engine, by *I. M. Swatman*, Solar Aircraft Company, and *D. E. Blackwood*, Bureau of Ships, Department of the Navy

2:00 p.m. — **Presidential Ballroom**

Regenerators and Compressors—Technical Session 6

Chairman: *S. Holm*, Ferrotherm Corp.

Vice-Chairman: *J. H. Anderson*, York Corp.

Gas-Turbine Rotary Regenerator—Design and Development of Prototype Unit, Unit for 3000-Hp Plant, by *W. E. Hammond* and *T. C. Evans*, The Air Preheater Corp.

Rotary Heat Exchangers, by *J. C. Miles*, University of Illinois

Worcester, Mass., Is Site for ASME Machine Design Conference

The 1956 Machine Design Conference of The American Society of Mechanical Engineers will be held April 10 and 11 at the Hotel Bancroft in Worcester, Mass. Worcester, being one of the world's largest inland industrial cities as well as an educational center with diversified, prosperous manufacturing plants, is an ideal location for this year's Machine Design Conference. Skill and craftsmanship in the best traditions of New England production keep Worcester progressively prosperous.

One of the high lights of this two-day Conference, arranged by the ASME Machine Design Division and Worcester Section, will be a symposium on "Automation—Where Is It Taking Us?" A panel of four speakers will represent four distinctly different viewpoints. Roger W. Bolz, editor of *Automation*, C. E. Evanson, president and general manager of the consulting firm of T. A. B. Engineers, Inc., Kurtz M. Hanson, president of The Champion-International Company, and Otis Brubaker of the United Steel Workers of America will discuss automation from the viewpoints they represent.

The Conference Ladies' Activity Committee has planned an interesting two days for the many women who will attend the Conference. On Tuesday, April 10, a trip to Old Sturbridge Village, a Yankee village of the early 1800's brought to life, is planned. Recreated on a 200-acre tract of meadow, woodland, and river shore, Old Sturbridge Village is a typical small New England farming community of a century and a half ago.

On Wednesday, April 11, a tour will be conducted to the John Woodman Higgins Armory. This Armory has one of the outstanding collections in the world of ancient and medieval armor and weapons.

The technical program follows:

TUESDAY, APRIL 10

9:30 a.m.

Session 1

Chairman: *Walter L. Abel*, United Shoe Machinery Corp., Beverly, Mass.

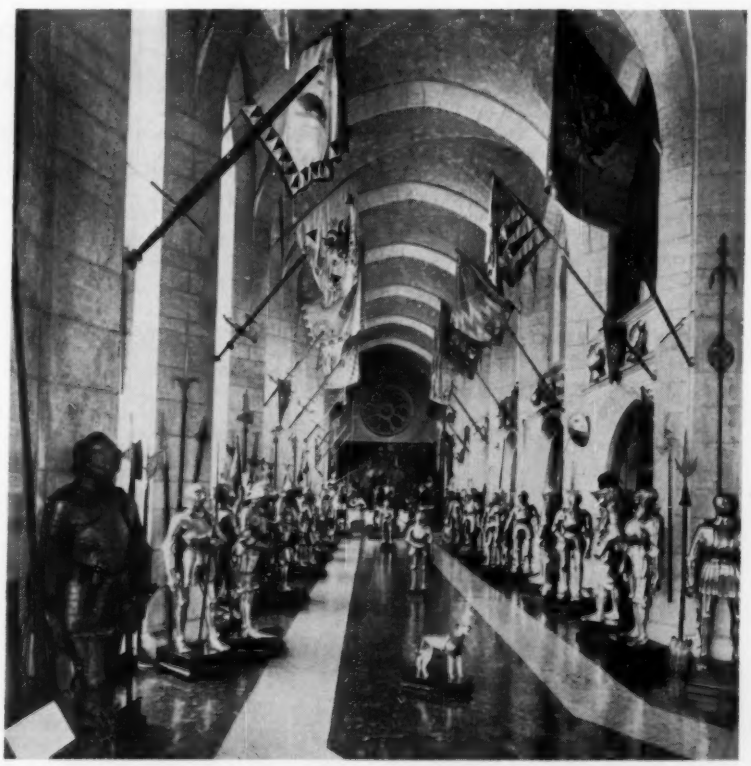
Vice-Chairman: *Robert S. Hahn*, Heald Machine Co., Worcester, Mass.

Automation for Assembly, by *Robert G. Dexter*, Barkley and Dexter, Inc., Fitchburg, Mass. (Paper No. 56—MD–2)

Automatic Assembly in a Ball-Bearing Plant, by *Henry Michelsen*, New Departure Division of General Motors Corp., Bristol, Conn. (Paper No. 56—MD–1)

12:30 p.m.

Luncheon



The Machine Design Conference program, April 10–11, at Worcester, Mass., includes a visit to the John Woodman Higgins Armory. The medieval wing of the museum, *shown,* houses an outstanding collection of armor and weapons.

2:30 p.m.

Session 2

Chairman: *Norman A. Wilson*, Morgan Construction Co., Worcester, Mass.

Vice-Chairman: *Fred N. Webster*, Worcester Polytechnic Institute, Worcester, Mass.

The Automatic Assembly of Electronic Components in Printed Wiring Boards, motion picture with informal discussion, by *Henry B. Kimball*, Research Division, United Shoe Machinery Corp., Beverly, Mass.

Some Degrees of Automatic Machinery Leading to Operatorless Machines, slides with informal discussion, by *Walter L. Abel*, United Shoe Machinery Corp., Beverly, Mass.

Evolution of the Iron Hand, by *Richard Melvin*, Sahlin Engineering Co., Birmingham, Mich.

6:30 p.m.

Social Hour

7:30 p.m.

Banquet

Address: *Charles H. Smiley*, Brown University, Providence, R. I.

WEDNESDAY, APRIL 11

9:30 a.m.

Session 3

Chairman: *A. Francis Townsend*, Heald Machine Co., Worcester, Mass.

Vice-Chairman: *Gordon T. Gurney*, Rockwood Sprinkler Co., Worcester, Mass.

Machine-Tool Automation and Feedback, *by Richard Russcsak*, Heald Machine Co., Worcester, Mass. (Paper No. 56—MD–3)

Remote-Control Handling Devices for Conducting Research Behind Shielding Walls, by *Frank Ring, Jr.*, Oak Ridge National Laboratory, Oak Ridge, Tenn. (Paper No. 56—MD–4)

Luncheon

2:30 p.m.

Session 4

Chairman: *John Haydock*, editor, *Metal-Working*, White Plains, N. Y.

Vice-Chairman: *Robert E. Pfeif*, General Electric Co., Worcester, Mass.

Symposium: **Automation—Where Is It Taking Us?**

Panel Members:
Roger W. Bolz, editor, *Automation*, Penton Building, Cleveland, Ohio
C. E. Evanson, president and general manager, T. A. B. Engineers, Inc., Chicago, Illinois
Kurtz M. Hanson, president, Champion International Paper Co., Lawrence, Mass.
Otis Brubaker, United Steel Workers of America

ASME Metals Engineering Division to Join With AWS in Spring Meeting, Buffalo, N. Y., May 7–11

Papers on welding nuclear-reactor components, a special session on safety, health, and fire prevention, and four sessions sponsored by the Metals Engineering Division of The American Society of Mechanical Engineers are some of the high lights of the 1956 American Welding Society spring meeting to be held in Buffalo, N. Y., May 7–11.

The technical program will be presented in 21 sessions and papers will range from technical reports on latest welding research to practical reviews of where and how welding is being successfully applied in industry.

For the first time the ASME Metals Engineering Division will meet with AWS and sponsor papers of parallel technical interest to both groups. The ASME papers will be presented at the following sessions: Welding of Dissimilar Metals, Welding of Type 347 Stainless Steel, Tests of Welds, and Higher Working Stresses in Pressure Vessels.

In a special session, sponsored by the AWS Technical Activities Committee, the vitally important subject of safety, health, and fire prevention will be discussed by safety experts. The papers will provide information on planning and executing safety programs and give many practical tips on best safety practices.

Memorial Auditorium, Buffalo, N. Y., where the Welding Show will be held May 7–11, in conjunction with the AWS annual meeting. ASME Metals Engineering Division will sponsor papers of interest to both groups.

The papers to be presented at the nuclear-reactor-components session will give information and data on the welding and brazing of reactor parts. The papers will cover fusion welding of zirconium, sodium corrosion, and oxidation resistance of high-temperature brazing alloys, and fabrication techniques used on a reactor test-vessel assembly. In all, some 60 papers will be presented by more that 100 engineers at the 21 technical sessions of the meeting.

In addition, a nontechnical conference on welding is being planned to be held at the auditorium for the benefit of production executives. This conference is designed to meet the needs of those interested in the practical aspects of welding in factories, but who are not required to keep abreast of laboratory research. An educational lecture series for engineering students also is being prepared.

Concurrently with the conference an exposition, the largest ever held in the welding field, will be on view. The Welding Show will exceed by one third the size of exhibits at the Kansas City, Mo., show in 1955, and by 28 per cent the record set when the show was last held in Buffalo in 1954.

Activities, social events, and technical sessions will be divided between the Memorial Auditorium and the Hotel Statler; they are located within easy walking distance of each other. The exposition, the welding conference, and the educational lecture series will be held at the Auditorium, while the technical sessions, the AWS annual meeting, and the social events will be at the hotel.

ASME Seeks Nominees for Williston Award

The American Society of Mechanical Engineers will confer the Arthur L. Williston Medal and Award "for fostering a spirit of civic service" for the first time this year. Names of nominees worthy of receiving such an award are sought. The competition will close in New York, N. Y., at noon on May 1, 1956.

Conditions of the Award

The Arthur L. Williston Medal and Award will consist of a medal and certificate, denoting a distinguished contribution, and also a sum of money. It will be granted to the undergraduate student in the Junior or Senior class of a course in mechanical engineering within an accredited school or college, or to a junior engineer who has had professional experience and who has received a baccalaureate degree within two years prior to the date of the granting of the award.

This award is given periodically to the young person who best qualifies for the purpose of: "Fostering a spirit of civic service."

Brief or Thesis

This award will be granted to the student or junior engineer who presents the best brief or thesis, which sets forth ideas or suggestions supported by appropriate argument regarding

The Arthur L. Williston Medal for fostering a spirit of civic service which will be awarded for the first time this year by The American Society of Mechanical Engineers

changes of curriculums, or additions thereto, variations of procedures or activities within the prescribed courses of study or in the extra-curriculum area of his school or college, that will tend to stimulate, foster, or develop increased interest in, sense of responsibility for, or urge to participate in social-service, civic, or public-spirited activities for the benefit of society or American civilization.

The brief or thesis, in general, should contain not less than about 2000 words, at least, and less than about 5000 words; it should be typewritten, bound, or placed within an appropriate folder, and presented in duplicate.

Persons desiring to compete for this award should send their contributions to the Secretary, ASME, 29 West 39th Street, New York, N. Y., by May 1, 1956.

ASME Team Reports on Recent Inspection Tour of Russian Manufacturing Plants

Report on Comparative Rates of Technological Progress, automotive and machine-tool industries, and technical education in the USSR

IMPRESSIONS of Russian technology at work were revealed at a press conference, held at the Hotel Statler, Washington, D. C., Jan. 17, 1956, for two of three members of The American Society of Mechanical Engineers who had shortly before returned from a two-week tour of Russian manufacturing plants.

The team chosen by ASME, at the request of the State Department (see January, 1956, issue of MECHANICAL ENGINEERING, page 108), included Nevin L. Bean, authority on automation and technical assistant to the general manager, Automatic Transmission Division, Ford Motor Company, Livonia, Mich.; Albert C. Hall, specialist in servomechanisms and control systems for missiles and high-speed aircraft, general manager of research, Bendix Aviation Corporation, Detroit, Mich.; and Weldon H. Brandt, engineering manager of the Westinghouse Electric Corporation, East Pittsburgh, Pa. Dr. Brandt was unable to attend the press conference.

Earlier that afternoon Mr. Bean and Dr. Hall had reported to the State Department on their trip. Among those to whom they reported was Carroll Woods, economic adviser in the Office of Eastern European Affairs. Mr. Woods presided at the press conference, which he opened with background information on how the trip came about. He told of the letter sent by Robert Murphy, Deputy Undersecretary of State, to C. E. Davies, secretary, ASME, asking the Society's cooperation in conducting a tour of American manufacturing plants for two Russian specialists in automation, at their request. An agreement was reached whereby the Russian visit would be followed by a similar visit to the Soviet Union on the part of American engineer-industrialists. Brig. Gen. Stewart E. Reimel, USA, retired, a consultant to ASME, was appointed to conduct the Russians on their tour.

The American team arrived in Russia, Dec. 7, 1955, and stayed until the 22nd. Mr. Woods explained that the team did not constitute an official American delegation, although it went with the approval of the State Department. Further, he explained, that the men did not go merely as representatives of the companies with which they are allied, although those companies paid their expenses. Some high lights of the press conference follow:

Scope of the Tour

The team visited four Russian cities: Moscow, Gorki, Stalingrad, and Leningrad. They inspected seven manufacturing plants, including an automobile plant, a tractor plant, a bearings plant, and a machine-tool plant, two institutes of the Academy of Science and the University of Moscow. They also visited the Russian equivalent of our National Bureau of Standards.

Dr. Hall, in discussing Russian plants visited, said they were chosen from a list that the Americans had submitted, which they thought were supposed to be the best of their kind, rather than typical; however, he demurred when asked whether he thought the plants were "showcases."

When the question arose as to whether they had been refused admission to any of the plants they wanted to see, Dr. Hall related that there was a tube-manufacturing plant and an electronic-manufacturing plant that they never got to see. However, Mr. Bean added that arrangements had not been fully worked out when the team arrived in the USSR. General Reimel remarked that the Russian team that visited this country did not get to see a transistor-manufacturing plant it had hoped to visit.

In answer to questions on the attitude of the Russian people, the men said that the Russians were friendly and interested in the Americans and that this became even more noticeable when they got outside Moscow. In some of the plants they said hundreds of people would stop work and come out to stare at them. Dr. Hall said, "We found it easy to get on common ground quickly on a technical basis."

Toward the end of the interview the men were asked what recommendations they would make to the Government as a result of impressions gained on their tour. Both hesitated to reply; then Mr. Bean pointed out that their calls on the State Department and other Government agencies during the day were only for the purpose of reporting facts. Dr. Hall said, "At this stage of the game we feel that they (the Russians) have a lot more to learn by visiting us than we have to learn by visiting them." He added that the Russians were moving fast, however.

Comparative Rates of Technological Progress

Several questions were asked on the comparison of the rate and present status of technological development between that of the United States and Russia. They seemed to think that the Russians have a long way to go before they catch up with us; in several areas, by all-out effort they are ahead of us; generally, they are progressing rapidly and may catch up with us unless we improve our performance. They are generally less efficient than we are, according to Mr. Bean, in that they use more man and woman-power to produce a given product.

"On items which they recognize as important," Dr. Hall said, "they move very fast." However, he pointed out that their record is spotty. Mr. Bean said, "Over all, they haven't caught up with us yet, but they do have peaks." They added that the areas in which the Russians are up to our level of production are: Antifriction-bearing and machine-

building industries. Furthermore, great progress has been made there in the manufacture of computing devices and in machine design.

"We were impressed," said Dr. Hall, "with the level of the technical people, with their spirit, enthusiasm, and teamwork." He said there was little sign of disaffection with the regime, probably because the people didn't know anything else. He said that they had a good incentive system; good, that is, from the point of view of the regime. A popular device is the "socialist competition," wherein one plant will challenge another in a race to improve production. Worker and management at the winning plant may get, for a period of time, bonuses amounting from 25 to 40 per cent of their annual salary. Mr. Bean added they had heard of one case where a worker in a winning plant got a bonus amounting to three months' pay.

Reporting the progress of research and development in Russia, Dr. Hall said, "At the University of Moscow we found that they encourage the professors to spend a good percentage of their time on research." He said that they had seen an advanced computer put together by the Institute of Calculating Technology. The Russians had used a large technical staff to do it, he added, although the computer featured nothing that we would regard as an innovation. Dr. Hall added, "I don't think we can be complacent about the technology race."

Automotive Industry

In discussing Russian automobile plants as compared with those of the United States, Mr. Bean said that they seem to be producing at a much higher rate on industrial products than on passenger cars. Their automotive manufacturing plants follow methods similar to ours, but the equipment is older. Their plants are not as highly automated as ours. Their assembly lines are quite orderly and resemble those of the U. S. Regarding the quality of the Russian product, Mr. Bean stated, "Judging by the ease of assembly, it is good. Everything went together very well."

Mr. Bean was reminded that he had said the Russian equipment was "older" than ours; he was asked how much older. He replied by saying that a lot of the Russian machinery resembled machinery we had thrown away years ago. American automakers, he remarked, have gone in more for single-purpose machines, such as the transfer machine.

Dr. Hall said, "They recognize that they are going to have to improve their production capabilities." At Gorki they are building close to 800 trucks a day and only 120 civilian cars, of a model called the Victory (Pobeda) which looks like a cross between the 1947 Nash and Ford. They are bringing out an improved car, the Volga, with an automatic transmission. Dr. Hall and Mr. Bean saw one of the handmade models, of which seven have been produced so far. They are now tooling up for mass production of the Volga. The new car will be a 70-hp, four-cylinder car weighing just under 3000 lb.

The team also saw the ZIM which is modeled after one of the older Packards and sells for 40,000 rubles ($10,000 at the official rate of exchange).

Machine-Tool Industry

Dr. Hall said they had seen a plant for building machine tools on a production-line basis, which is something we do not do in this country. At one plant, he added, they were building 50 semiautomatic lathes a day, whereas we turn out something like 1000 a year.

Mr. Bean said that the Russians produce lathes on continuous assembly lines which are kept constantly busy. He explained that one reason that this happens in the USSR and not in the U. S. is that machine tools in America are produced by competing firms, each with its own designs, whereas design is standardized by government agencies in Russia.

Dr. Hall said that the Russians follow the American practice of looking at the competitor's product and then trying to improve on it, the "competitor" in this case being the whole of American industry.

Technical Education

Mr. Bean said they had been told by a vice-president of Moscow State University that there are more than 1,700,000 students enrolled in Soviet institutions of higher learning, and that of these more than 800,000 are in technological and scientific branches. Dr. Hall said that students are paid when they reach these higher institutions, and that they get additional money for high marks. Mr. Bean said that they must maintain their averages or face changes in their curriculums, if not outright expulsion.

Random Impressions

Dr. Hall said they were not taken to see aircraft plants, but they had flown in some of the Soviet "commercial" planes, which were pretty old, about like our DC-3, but more powerful.

Mr. Bean said the members of the team may have been the first Americans to get a good look at the new Leningrad subway system. Eight stations have been completed so far, he said, and all are beautiful and "would have done justice to the interior of any American building." The stations are more modernistic than those of Moscow and are served by escalators with extremely long runs. The Leningrad project represented a major engineering problem because of the city's marshy terrain. Mr. Bean thought that the reason for this gaudy project in an austere period is Leningrad's traditional keen competitive attitude toward Moscow, whose 28-station system has long been one of the chief Russian conversation pieces.

Mr. Bean stated that about half the employees in the plants are women and that there seemed to be no differential in assignment of manual responsibility or in pay between the sexes.

Mr. Bean reported that there did not seem to be much evidence of the military in manufacturing plants.

EJC General Assembly Points to Needs for Improved Utilization of Engineering Manpower

The second Engineers Joint Council General Assembly, held at the Hotel Statler, New York, N. Y., Jan. 26–27, 1956, brought a large, diverse audience, including persons from industry, higher and junior education, research organizations, Government and military representatives. The American Society of Mechanical Engineers, a constituent society of EJC, was represented by several members who took an active part in the program. The Assembly developed a sense of urgency with respect to the problems of manpower and the utilization of engineers and scientists.

Technical Program

The program was presented in four sessions covering the following topics: Reserve Forces Act of 1955, Extending Engineering Manpower by Utilizing Balanced Teams of Engineers and Engineering Technicians, Growth Pattern of the Engineer, and The Hoover Commission Reports—a review of the engineering aspects.

The first session, on Thursday, January 26, was cosponsored by the Conference on Scientific Manpower, which includes the Engineering Manpower Commission, Scientific Manpower Commission, National Research Council, and the National Science Foundation. This session was devoted to a report and discussion of the meaning of Public Law 305—the Reserve Forces Act of 1955—to the utilization of engineers, scientists, and certain persons who have critical skills.

Carter L. Burgess, Assistant Secretary of Defense, manpower and personnel, who was detained in Washington, D. C., on Government business, was represented by Albert Kay. The emphasis, in this paper, was on the realism of President Eisenhower's Reserve Program in the light of present conditions and future dangers.

Major General Lewis B. Hershey, Director of Selective Service System, said the nation has come a long way in rebuilding its military strength since 1950. Among other factors, power—extreme power in a small package—adds to the uncertainty we have as to our best, most hopeful course of action. Our uncertainties can be traced directly to our fears.

We fear that we are being outproduced in scientists, in engineers, and in technicians. There is no disposition to suggest that these fears are not real. "Last August the Reserve Act was passed. The results expected by some have not yet been achieved, but the fact remains that the act did provide for increased responsibilities for the Selective Service System in the administration of the Reserves, both Ready and Standby."

Brig. Gen. Carlton S. Dargusch, Assistant Director for Manpower, Office of Defense Mobilization, discussed the role of the office of Defense Mobilization in the development and utilization of specialized manpower including scientists and engineers, outlining programs under way in the ODM to fulfill its major mobilization responsibilities in this field.

Brain Power—Our Greatest Asset

Frank H. Bowles, director of the College Entrance Examination Board, was principal speaker at the opening-day luncheon. His topic was "Brain Power—Our Greatest Asset." He stated that the problem of the availability of brain power for the maintenance of our economic and social organization is really two separate problems closely related. "The first," he stated, "has to do with the present operation of our educational system which seems to be failing to hold, to the point of maximum return, a very large number of able individuals. This immediate problem is to be closely followed by that related to the ability of our education system to double its capacity within the next decade.

"Together, these problems," Mr. Bowles stated, "are both related to the question which concerns us today as to whether our schools and colleges can produce in the form of workers, technicians, engineers, scientists, and administrators, the brain power we must have to keep our economic and social organization going."

Mr. Bowles cited the various large corporate scholarship programs, such as the Ford Foundation, as one set of answers to the problem. He indicated the sheer common sense of this approach which will be found by anyone who compares the money that is to go into development and expansion of our industrial and commercial structures with the money that is scheduled to go into education. He stated that the latter, if present apparent plans are followed, will be only a disproportionately small fraction of that for general industrial and business expansion. He supported his thesis by citing the two functions that education has performed during the last fifty years. It has removed a larger and larger proportion of school-age youth from the labor force to be returned at some later date as far more productive persons. He pointed out, however, that this process is getting to a point of diminishing returns because the reserve, those capable people of educational age not in school, is far smaller than ever before. He then presented a statistical analysis which indicated that our reserve of brain-power potential in terms of absolute numbers as well as percentages is running short. "It is this fact that we are running short of brain power that has aroused our interest in the development of human resources that have hitherto been unregarded."

He cited the results of a study of undeveloped brain power recently completed by the College Entrance Examination Board which indicated that an ever-increasing large amount of efforts of various kinds will be needed to encourage the education of this ever-diminishing potential group. The conclusions are: (1) Our brain power group is not large. (2) The number of the high-ability students who graduate from college cannot under present circumstances be increased greatly. "From these facts it is clear enough," he stated, "that no great quantity of salvation is to be expected from efforts to stimulate the increase in the output of educated brain power through such devices as scholarship programs. There will be some results, of course, but they will not be startling nor, except for huge sums of money, numerically important."

Hoover Commission

S. C. Hollister, dean, School of Engineering, Cornell University, Ithaca, N. Y., was the luncheon speaker on Friday, January 27. He spoke on the Major Findings of the Hoover Commission. The report was published in the February, 1956, issue of MECHANICAL ENGINEERING. Later in the afternoon the session was devoted to the Hoover Commission reports giving a review of the engineering aspects. Dr. Mervin Kelly, president, Bell Telephone Laboratories, New York, N. Y., talked on research and development; and Admiral Ben Morcell, chairman of the board of Jones & Laughlin Steel Corp., Pittsburgh, Pa., discussed the water resources. Admiral Moreell served as chairman of the Task Force on Water Resources and Power of the Second Hoover Commission.

"I believe the most important conclusion of the Task Force is that the activities of the Federal Government in this vital and costly field have grown like Topsy, with no central supervision except a 'once-over-lightly' by the Bureau of the Budget," he said. "Huge sums have been spent without benefit of any clear-cut, unified body of Federal policy. . .The current policies, taken together, are a hodgepodge of contradictions which generate conflicts among agencies, overlapping of functions, competition for position, and wasteful expenditures."

The huge losses in revenue from power sales have resulted, Admiral Moreell said, because "we found that if all federal-power rates had been based on power values in accordance with Federal Power Commission methods, as applied to private producers, the rates would be increased by 30 to 50 per cent and the Government would have received $130 million more in power income in 1953 alone."

Nuclear Power

Walker L. Cisler, Fellow ASME, and president, Detroit Edison Company, was the speaker at the banquet which concluded the two-day meeting. Mr. Cisler chose as his topic "A World Look at Usefulness of Nuclear Power."

"Throughout the world, human progress and the utilization of energy go hand in hand. Atomic power appears to be the answer to a universal drive toward better living through expanded utilization of energy," said Mr. Cisler. Estimates of world energy resources made public at the Geneva Conference for the Peaceful Uses of Atomic Power, last summer, showed the need to double electric and other forms of power output by 1975 and to redouble power production by the year 2000, he pointed out. The Geneva studies indicated that, at this rate, world resources of conventional fuels would be reduced to 300 years' supply or less by the turn of the century.

Use of atomic fuels not only can supplement oil, coal, and gas supplies in the future, he said, but has particular importance because nuclear fuels can be transported so easily to fuel-poor and underdeveloped areas of the world.

"We must have reactors," he said, "with the demonstrated ability to operate economically and in a manner satisfactory for electric-power-system service."

Without question atomic energy ultimately will have great usefulness throughout the world. Whether there is sufficient will to overcome the many limiting factors cannot be foreseen at this time.

During the EJC General Assembly there was opportunity for friends to meet. *Left to right* are: Thorndike Saville, EJC President; O. B. Schier, 2nd, assistant secretary ASME; D. W. R. Morgan, past-president and Fellow ASME; and Ben G. Elliott, Vice-President, Region VI and Fellow ASME.

Junior Forum

Conducted for the National Junior Committee

by R. A. Cederberg,[1] Assoc. Mem. ASME

Professional Acceptance Through Public Recognition

By H. N. Weinberg[2]

With the rapid progress in scientific achievement over the past two decades has come an ever-increasing demand for engineers to operate and expand our technological civilization. Unfortunately, although the engineer is the "man of the hour," he has not attained in the public mind the professional status which is accorded to doctors, lawyers, or dentists.

It is not that engineers do not deserve professional status, nor can it be said that many individual engineers have not achieved, in full measure, the material rewards and inner satisfaction which are characteristic of the professional status. But as a group, engineers have not been wholly received into the sanctity of the professional classification.

Certainly the term "engineer" does not evoke the respect and admiration that does, say, attorney-at-law or doctor of medicine. Although progress is being made, the engineer does not command financial remuneration commensurate with his contribution to mankind. And, until we achieve true professional recognition our status in the community and emoluments will not be on the professional level.

One reason for this situation is that only a few decades ago many engineers were considered little more than mechanics from a trade school. Many phases of activity which carried the name engineer bore no resemblance to what we engineers think of as engineering today. Now, many of these attitudes have become a permanent part of the public thinking. Until we can convince non-engineers, as we are convinced, that we are professional men and stand far apart from the many trades that like to masquerade as engineers, the term will continue to denote such activities as train operators, sheet-metal workers, and the like.

Professional Acceptance

The task of achieving professional acceptance is one which all engineers must shoulder. The older men have taken great strides by maintaining high standards of individual conduct and by the establishment and active support of our engineering societies which are, in effect, dynamic embodiments of the professional spirit. We younger men, who certainly have the most to gain, should by every possible means strive to achieve individual professional recognition and professional status for all engineering activity.

Engineering must not be considered an 8-hour job any more than is medicine. We should accustom ourselves to the fact that professionalism is a constant display of excellence in all that we do and, accordingly, we must develop a professional attitude toward all of our activities. If we think professionally we will act professionally, which means that we will assume dignity in all we do and say. Above all, as professional men we will zealously guard the use of our time and effort, limiting ourselves to creative engineering work, leaving the semitechnical and clerical for the technicians and others. This last is easy to say but the vast majority of engineers are not self-employed and do not have complete freedom in choice of assignments. However, it is to an employer's benefit to keep his engineers on a professional level (the more successful companies are doing this) and it will behoove the engineer who is not being utilized properly to try and set matters straight.

As a matter of fact, some companies apparently having found it increasingly difficult to hire engineers who will accept semiprofessional tasks, have advertised for college graduates to whom they will give "engineering training." These companies should be commended for facing up to the problem. But in the interests of professionalism we should urge that the term engineering training not be used to mean what may really be training of a vocational nature.

Since our work is not well understood, it is difficult for the public to appreciate us as they do the men who cure their ills and guard their legal rights. Most people are only vaguely aware of the engineer's contribution to civilization. They do not recognize the combination of technical competence, judgment, creative thought, and practicality which qualify engineers for professional status. To obtain a sympathetic public we will have to explain what we do and why we do it—what engineering is and what it aspires to be. Therefore each of us individually, and the profession as a whole, through our societies and organizations, must undertake positive action. We must spread the idea through words as well as accomplishments that the terms engineering and engineer specifically mean professionalism of the highest order.

Naturally, as individuals we are limited both in the scope and effectiveness of our activities. Fortunately, our individual efforts can be magnified many thousandfold and most effectively directed through such societies and organizations as the ASME and the Engineers Joint Council. This is one of the most cogent reasons for joining in the activities of the Society on every level.

Educational Campaign

One immensely desirable positive action we could initiate through our societies is an educational campaign via such mass media as television, radio, and the movies. Industry could probably be convinced to sponsor programs telling the engineer's story because industry would reap not merely the advertising benefits but possibly a greater benefit by attracting more people into engineering. The potential return to the engineering profession and industry on a small investment of our combined efforts is exciting to contemplate.

Civic Responsibility

As professional men, we also have civic responsibilities to fulfill, responsibilities which many of us have been shirking to date. For instance, last year 58 per cent of the governors were lawyers; 0 per cent were engineers; 55 per cent of the U. S. Senators were lawyers; 2.1 per cent were engineers. If we are to be professional men we must accept our civic responsibilities. We must provide reasoned and responsible leadership based upon the principles of truth and logic by means of which we have helped build our modern world.

The Hon. Thomas C. Desmond, in his Roy V. Wright Lecture in 1954, went straight to the heart of the matter when he said, "engineers are certainly not the only kind of informed men who can give or should provide leadership, but to engineers in particular, in this modern age of technology such acceptance now, is a special obligation. It will give satisfaction to any engineer to realize that he is doing his share to maintain reliable, efficient, or democratic institutions."

In line with our broad civic responsibility there is one specific obligation which we owe to ourselves as engineers as well as to the general public. That is, to define legally the term engineer and insist that only those legally entitled may use the name.

Over all then, there is work to be done by the younger men individually and in concert, for themselves and for the profession. The choice is with us alone. We either must seize the initiative and reach the professional stratum with its corresponding rewards or accept economic mediocrity.

This article, as have others in the past, has been intended to stimulate the Associates to thought and action. If any of you have any idea on the subject of professionalism, or any other subject for that matter, which you feel should be discussed through "Junior Forum," we urge you to put your comments on paper and forward them to your National Junior Committee.

Acknowledgment: Some of the thoughts contained herein were inspired by Prof. Emmet E. Day's excellent lecture, "This Is My Profession," delivered at the Students' and Members' Luncheon in New York, N. Y., during the 1954 ASME Annual Meeting.

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ASME Codes and Standards Workshop

Boiler and Pressure Vessel Code

THE ASME Boiler and Pressure Vessel Committee by delegation from the American Standards Association holds the secretariat of the International Standards Organization Committee TC/11 on stationary boilers. A special committee of the Boiler and Pressure Vessel Committee under the chairmanship of F. X. Gilg has been exercising the duties of the secretariat and has developed a code which was reviewed at a plenary session of TC/11 held in Madrid, Spain, Feb. 7 to 24, 1956.

Plumbing Standardization Following the Issuance of the American Standard Plumbing Code (ASA A40.8-1955)

The sponsors of the code recommended that the project be divided into two separate section committees—one covering plumbing equipment and one governing the performance code. ASME has accepted administrative sponsorship of the project covering plumbing equipment with the American Society of Sanitary Engineering as co-sponsor. This project, known as A112, is in the process of being organized.

Fundamentals of Performance of Effluent Air and Gas Cleaning Equipment

On March 17, 1954, a conference called by the American Standards Association recommended that a project be organized with the following scope: "Development of standards relating to fundamentals of performance of effluent air and gas cleaning equipment or devices used for the treatment of process effluent." The ASME was asked to serve as administrative sponsor with the American Society of Heating and Air Conditioning Engineers as co-sponsor. This project is under development.

Parking Garage Elevators

The Sectional Committee A17, Safety Code for Elevators, suggested to the American Standards Association that new standards for safety in automatic parking garages were necessary. The American Standards Association authorized the formation of a new sectional committee, under the sponsorship of ASME, to formulate proposed regulations for this equipment. Invitations have been extended to organizations known to be interested. It is anticipated that the committee will hold its organization meeting in the near future.

Safety Code for Conveyors, Cable Ways, and Related Equipment (B20)

A subcommittee has been appointed to develop a safety code for passenger conveyers.

Power Test Codes

1 Power Test Codes Committee No. 10, covering centrifugal and turbocompressors and blowers, has been reorganized to broaden the scope of the code to govern gases other than air.

2 A new committee covering the governing of internal-combustion engine-generator units is in the final stages of organization.

3. Determination of dust concentration in a gas stream. Chairman M. D. Engle states that the personnel of the committee will be ready for submission for approval by May, 1956.

4 Measurement of Small Particulate Matter. Chairman W. A. Crandall has submitted a list of persons who might be invited to accept appointment on the technical committee.

5 Governing of Hydraulic Turbine-Generator Units. The Main Power Test Code Committee, at its meeting on Dec. 15, 1955, recommended the organization of a technical committee to develop a test code covering the governing of hydraulic turbine-generator units.

NSF Awards Grants for Summer Institutes for Teachers of Science and Mathematics

TWENTY-TWO grants designed to point the way to improved teaching of science and mathematics in the nation's high schools and colleges are announced by Alan T. Waterman, Director of the National Science Foundation. The grants, totaling more than a million dollars, have been awarded to colleges, universities, and professional societies for the purpose of conducting institutes led by outstanding scientists, engineers, and mathematicians for high-school and college teachers in these fields. Twenty of the grants are in support of summer institutes to be held during the summer of 1956. Two of the grants are for experimental institutes to be conducted throughout the academic year 1956–1957.

"Existing and potential shortages of scientists and engineers threaten our national economic and social welfare as well as the national defense," Dr. Waterman declared in announcing the grants. "It is important that private industry, state and local governments, citizens' groups, and the Federal Government unite their efforts to see that our educational system is able to provide adequate training in technical fields for highly qualified persons in sufficient numbers. The teaching of science, mathematics, and engineering not only presupposes specialized training, but advances in these fields are so rapid today that continuing effort must be made to keep our teachers abreast of recent developments. Since many teachers operate on salaries that make it impossible for them to finance refresher courses for themselves or to give up extra work during the summer for the purpose of studying in universities or research laboratories, support for these purposes is both desirable and necessary."

Dr. Waterman expressed the hope that private foundations and industrial organizations already actively supporting similar programs will find it possible to expand their efforts. The Foundation program, now in its fourth consecutive year, is an experiment designed to stimulate, through demonstration, the creation of opportunities for college and high-school teachers to attend courses in science and relevant fields especially designed for teachers and conducted by leaders noted not only for competence in their fields but for skill in presentation. The foundation maintains continuous review and appraisal of the program, and the favorable reception it has been accorded to date indicates that it is a successful experiment.

Grants for summer institutes will provide financial assistance to more than 1000 participating teachers, approximately 50 at each institute, and additional allowances for dependents. Grants for the academic-year institutes will provide stipends of $3000 each to 50 teachers in each institute. Additional allowances for dependents will also be provided.

Actions of the ASME Executive Committee

At a Meeting at Headquarters, Feb. 3, 1956

A MEETING of the Executive Committee of the Council was held Friday, Feb. 3, 1956, at 9:30 a.m. in the rooms of the Society. There were present: Joseph W. Barker, chairman, F. L. Bradley, F. W. Miller, and A. C. Pasini of the Committee; H. J. Bauer, chairman, Finance Committee; G. M. Muschamp, chairman, Organization Committee; E. J. Kates, assistant treasurer; D. W. R. Morgan and E. G. Bailey, past-presidents; W. H. Byrne, vice-president; E. O. Bergman, R. B. Lea, and Joseph Pope, directors; W. F. Thompson, former vice-president; C. E. Davies, secretary; D. C. A. Bosworth, T. A. Marshall, Jr., O. B. Schier, 2nd, assistant secretaries; and Ernest Hartford, consultant. The following actions are of general interest:

Dinner Meeting, February 2

A dinner meeting was held at the Engineers' Club, New York, N. Y., Feb. 2, 1956, at 6:30 p.m., at which members of the Executive Committee met with ASME representatives

of United Engineering Trustees, Inc., The Engineering Foundation, and the Engineering Societies Library Board.

The ASME representatives on each of the joint agencies summarized their respective problems and plans. Discussion lasted approximately two hours.

Revision of 1955–1956 Budget

Upon recommendation of the Finance Committee, at its meeting on Jan. 18, 1956, the Executive Committee of the Council voted to approve the revised budget for 1955–1956.

Applied Mechanics Division

A custodian account for the Applied Mechanics Division, for expenditures and accounting, under the procedure of the Society, was authorized.

Student Branches

Upon recommendation of Vice-President A. C. Pasini, the Executive Committee voted to authorize the establishment of a Student Branch at Youngstown University, Youngstown, Ohio, which is an accredited institution.

1956 Spring Meeting

The following members of the Council were designated to serve as representatives at the Portland Spring Meeting, March 18–21, 1956: Joseph W. Barker, President, E. O. Bergman, B. G. Elliott, Bryan T. McMinn, and J. F. Downie Smith.

Technology Executives' Conference

President Barker reported that the Technology Executives' Conference held at Ann Arbor, Mich., Jan. 30–31 (see pages 279–284 of this issue) was highly successful and expressed the regret that more members of the Council and Section leaders had not had the opportunity to participate and gain an understanding of the way the technical work of the Society is being developed. He suggested that consideration be given to enlarging the Conference and holding it at the Semi-Annual Meeting. This question was discussed at some length as was an alternative idea of having representatives of the Technology Conference meet with the Regional Delegates. President Barker also pointed out that the Board on Technology would meet with the vice-presidents on the evening of Feb. 24, 1956. The Secretary was requested to consider these various suggestions and make recommendation at the next meeting of the Executive Committee.

ASME Motion Picture

Assistant secretary Marshall reported that from Nov. 1, 1955, to Jan. 31, 1956, 56 showings had been made of the ASME motion picture, before 7800 people. He reported that six prints of the picture had been sold, all to engineering schools. A follow-up is being sent to industry.

Increased Financial Needs of Society

President Barker reported a communication from Glenn B. Warren, director, which anticipated that increasing future services required by ASME members might necessitate an increase in dues and he submitted a plan having some relationship to individual earning power. The future financial needs of the Society were discussed briefly. The Finance Committee is working on a five-year program estimating income and costs. In the meantime the Executive Committee of the Council felt that some policy matters should be considered and voted to authorize the President to appoint a small committee to consider the broad problem of Society income.

Certificates of Award

Certificates of Award were granted to H. R. Westcott, retiring chairman of the Board on Honors, and J. C. Barnaby, who will retire as chairman of the Oil and Gas Power Division this year. Certificates of Award were granted to the following retiring chairmen of Sections: St. Joseph Valley Section, A. G. Strandhagen; Southern Tier Section, J. R. Blizard.

New Engineering Societies Building

E. G. Bailey, one of the three ASME representatives on the Task Committee on Engineering Societies Center, presented a progress report of the work of that Committee.

Power Show Advisory Committee

The Executive Committee of the Council voted to approve the following to serve as ASME representatives on the 1956 Advisory Committee for the Power Show as required in the contract between the Society and the International Exposition Company: President J. W. Barker; Directors on Board on Technology, R. B. Lea, J. F. Downie Smith, G. A. Hawkins, and G. B. Warren; Chairman, Board on Technology, A. W. Thorson; Chairman, Meetings Committee, J. H. Davis; and Secretary C. E. Davies.

Verein Deutscher Ingenieure

The Executive Committee appointed the following persons to serve as Honorary Vice-Presidents at the centennial celebration of the VDI to be held in Berlin, Germany, May 12–15, 1956: Lillian M. Gilbreth, R. L. Goetzenberger, E. C. Keachie, and R. H. Bacon.

E. B. Ricketts

The members of the Executive Committee noted with sincere regret the death on Jan. 8, 1956, of E. B. Ricketts who served as vice-president, 1940–1942.

Presidential Representatives

The Executive Committee noted the following appointments of presidential representatives: University of Florida, Inauguration of President, Feb. 17, 1956, Paul R. Yopp; International Standardization Organization (TC-11) Meeting, Madrid, Spain, Feb. 7–24, 1956, E. O. Bergman, F. X. Gilg, E. C. Korten, J. L. Menson, C. W. Wheatley, and F. S. G. Williams; National Society of Professional Engineers, dedication of National Headquarters Building, Washington, D. C., Feb. 17, 1956, W. H. Byrne.

Engineering Societies Personnel Service, Inc.

These items are from information furnished by the Engineering Societies Personnel Service, Inc., in co-operation with the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to all engineers, members or nonmembers, and is operated on a nonprofit basis.

In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrant members whose availability notices appear in these columns. Apply by letter, addressed to the key number indicated, and mail to the New York office.

When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available at a subscription of $3.50 per quarter or $12 per annum for members, $4.50 per quarter for nonmembers, payable in advance.

New York
8 West 40th St.

Chicago
84 East Randolph St.

Detroit
100 Farnsworth Ave.

San Francisco
57 Post St.

Men Available[1]

[1] All men listed hold some form of ASME membership.

Plant Manager, mechanical engineer, 45, work in civil, electrical, chemical fields; 15 years' background in plant layout, maintenance, factory methods and processes, production, and assembly. Proved ability to organize, direct, co-ordinate, and

control. Salary commensurate with position location and investment opportunities. Prefers West. Me-284-S.F.-11-San Francisco.

Mechanical Engineer, BS, eight years' varied project, plant, and manufacturing-engineering experience. Energetic, with initiative, and ability to get things done. Desires position with future and more responsibility; plant engineer, administrative assistant. Prefers Northern N. J. Me-285.

Mechanical Engineer, creative engineer, over 15 years' responsible experience with nationally known corporation in the design, development, and sale of new products, processes, and production equipment. Outstanding record of accomplishments in the creation of practical and profitable new lines. Me-286.

Plant-Process Engineer, 34, honor engineering graduate; 10 years' experience textile finishing, maintenance, machine design, cost study, patents, development; writing ability; expert technical German and Swedish; licensed professional engineer. New York metropolitan area. Me-287.

Technical Executive, ME, advanced degree; 20 years' experience; can direct department or assist top executive. Broad interests in design, development, research, and technical planning or analysis, light to heavy mechanical products and related fields. Developer of productive personnel and effective approaches. Me-288.

Engineer, management position; 33; BSIE; 4½ years' diversified experience. Successful accomplishment in all phases of industrial-engineering activities; incentives, standards, cost, plant layout, cost reduction, controls, and supervision in production and job shop. Desires broader responsibilities. Prefers N. Y. or N. J. Me-289.

Positions Available

Manufacturing Engineer, 32–40, engineering degree, preferably mechanical. Must have practical experience and knowledge in metal fabricating, finishing, assembly, tooling, automation, and mass-production methods; be able to maintain an effective and pleasant working liaison. Will be in charge of manufacturing-engineering department reporting to the plant manufacturer and providing services in connection with the application of approved I.E. policies and operating performance, reducing waste and delays and otherwise promoting cost reductions and a high level of efficiency. $8000–$10,000. Conn. W-2782.

Mechanical Engineer, power plant, rated at 400,000 lb per hour, generated at 200 psi; graduate, three to four years of progressively responsible experience in power-plant operation and maintenance for operation and maintenance of the power plant, steam-distribution systems, and equipment related thereto, design and plan alteration, construction, and other projects. About $6000. Upstate N. Y. W-2790.

Maintenance Superintendent, 30–44, BS or the equivalent in mechanical engineering. Must have a minimum of five years' experience in mechanical maintenance; must have some supervisory experience and ability, mechanical or electrical experience would be helpful; to supervise maintenance foremen. Will plan, organize, and direct all activities necessary to maintain plant facilities and equipment. Salary open. Pa. W-2815.

Instructor, in machine design; PhD level, young; interested in teaching and fundamental research. Relative light teaching load on undergraduate and graduate levels. Opportunity for consulting work. Previous teaching experience desirable but not required. Southwest. W-2831.

Production Manager, mechanical-engineering training and at least ten years' methods, tooling, and manufacturing experience on close-precision products, gages, etc. Salary open. Mich. W-2841D.

Plant Engineer, 30–35, mechanical graduate, at least five years' plant engineering, machinery, and building-maintenance experience for paper converting manufacturer. $7200–$8400. Western Mass. W-2843.

Teaching Personnel, mechanical-engineering department, to teach courses in the heat-power field, both lecture and laboratory. Salary and rank open; will depend upon qualifications. Ohio. W-2847.

Research Assistants, full or part-time employment, on projects in mechanics with emphasis on elasticity, vibrations, and electrical instrumentation. Experience in applied mathematics or electromechanics desired. Opportunity for graduate study commensurate with research duties available in engineering mechanics, civil engineering, mechanical engineering, and applied mathematics. To $6000 for full time; ten months' employment. Fla. W-2848.

Engineers. (*a*) Senior development engineer, mechanical graduate for research and development work. Should have ten to 20 years' experience in designing and development of heavy machinery, rolling mills, and hydraulic presses. $10,000 and up, depending upon experience. (*b*) Junior engineer in same field as aforementioned, with roughly the same qualifications, but with less experience. $7500–$8000 a year. Western Pa. W-2849.

Publications Manager, 30–40, experience in commercial-magazine production work. Duties will include handling advertising orders, editorial copy, layout, type selection, some nontechnical rewrite, liaison with printer, and organization of complete operations. To $9600. Western Pa. W-2851.

Chief Engineer, graduate, 40–45, mechanical plus some electrical experience, for a large firm of consultants. Should also have business background and ability to meet customers. $12,000–$15,000. Mass. W-2858.

Engineers. (*a*) Foundry superintendent, at least ten years' foundry-production experience, to supervise operations and assist general manager, N. Y. State. (*b*) Industrial engineer, textile-engineering experience covering spinning, weaving, and general mill experience. Salaries open. Foreign assignment. W-2860.

Engineers. (*a*) Chief engineer, mechanical or electrical graduate, at least ten years' chief project-engineering experience in electronic component manufacturing. $12,000. (*c*) Quality-control manager, statistical quality control and considerable machine-shop, light stamping, and assembly experience covering small switches, connectors, and radio hardware. $8000–$10,000. (*d*) Methods and process engineer, mechanical training and considerable process-sheet-writing experience. $6000–$8000. New England. W-2861.

Plant Manager, production management, planning cost, and budget experience covering refrigeration equipment, sheet metal, and control instrumentation. $10,000, plus bonus. Va. W-2878.

Designers, electrical, mechanical, and electronic; college degree, a minimum of four years' experience. $8000, plus $56 per diem allowance for a week. Company will pay placement fee. Syracuse, N. Y. W-2881.

Time-Study Engineer, minimum of three years' experience on time-study work for management consulting firm. Will be assigned to semi-permanent location both in midwest and east. $7200–$9000, plus diem allowances. Headquarters, New York, N. Y. W-2883.

Plant Engineer, plant of approximately 2000 employees. Will be responsible for supervision and direction of plant-engineering department including construction engineering, utilities engineering, utilities operation, general maintenance and grounds maintenance; construction and maintenance of buildings and grounds; installation of all machinery equipment not specifically assigned to other departments; initiation and preparation of drawings, records, studies, plan estimates, and recommendations. $9000–$10,000. Southern N. J. W-2891.

Industrial Engineer, 35–45, to take charge of time and motion studies, production-control records for company engaged in paper processing. Experience in this work most desirable. $8000–$10,000. N. Y. State. W-2894.

Professor, industrial or mechanical graduate, ten years' industrial experience in industry to establish and maintain a combination of advisory and liaison relation between industry and engineering-experimental station of a recognized university. $8000. Midwest. W-2896.

Packaging Engineer, production and management experience covering coating, laminations, aluminum packages, plastic bottles, tubes, and machinery for high-speed wrapping, automatic application of bands, etc. $15,000 plus extras. Austria. F-2904.

Mechanical Engineer, graduate, at least three years' covering analytical and experimental work in the development of hydraulic, pneumatic, and mechanical systems; in high-voltage power-switchgear fields. $6000–$7200. State of Washington. W-2905S.

Supervision Planning and Analysis, 25–35, industrial engineer, or engineering administration; several years' production-control background consisting primarily of actual production scheduling at plant level. Experience in time study and other phases of industrial engineering also necessary. Salary open. Ohio. W-2910.

Heating, Ventilating, and Air-Conditioning Engineer, 30–45, from five to ten years experience in layout specifications writing, erection, and servicing of industrial-ventilation equipment. Staff position; considerable traveling to other plants. $7200. Headquarters, New York, N. Y. W-2922.

Vice-President, graduate mechanical, about 45, experience in the engineering and production of capital goods, especially in the power field, some acquaintance with developments in nuclear-fuel power applications. $30,000. East. W-2931.

Machine Designer, graduate mechanical, for small firm of consulting engineers, including experimental machine shop retained on an annual basis by a group of companies to do development engineering. Salary, plus profit sharing. Company will pay placement fee. Va. W-2933.

Design Engineer, mechanical or electrical, for technical direction of wire insulation involving subconstruction, design of special machinery, and actual production work. Must have had three to five years' experience preferably in wire insulation. Six months in Chicago, Ill., and then will relocate to central Ky. W-2935.

Design Engineers, graduate mechanical, electrical, and structural, for work on heavy-building construction, foundations, installation of equipment, and substations and distribution. Salary open. Conn. W-2938.

Design Engineers, degree, 25–45, three years' experience in airframe or missile. Capable of production design, research, and development, to supervise junior engineers and draftsmen and make strength checks, designing any major portions of entire plane or any components such as power plant, power units, heating and ventilating, etc. Possible travel. $5200–$9300. Company will pay placement fee. Kan. C-4402.

Test Engineer, degree, 25–45, three years' experience in airframe or missile, to supervise engineering testing of an experimental nature which includes flight tests, aircraft systems, and components, both in aircraft and on ground and on special bench or test-rig setups. Responsible for test procedure, proper instrumentation, data reductions, and reporting test results and designs for any special test equipment or fixtures needed; interpret specifications, outline, and conduct tests. $5200–$9300. Employer will pay placement fee. Kan. C-4403.

Dynamic and Flutter Group Engineer, degree, 25–45, three years' airframe or missile experience, primarily concerned with safety and design problems associated with vibration, shock, and impact; effect of landing shock and rough air and maneuvers are studied; fatigue tests are run to determine structural failings; propeller static and vibratory stress problems are investigated. Possible travel. $5200–$9300. Employer will pay placement fee. Kan. C-4408.

Weight-Control Engineer, degree, 25–45, three years' experience in airframe or missiles, who is interested in total weight and balance of airplanes; to estimate weight and balance, write weight reports, actually weigh the plane and components, determine good weight design versus strength and utility, and tabulate the weight growth of plane. Possible travel. $5200–$9300. Employer will pay placement fee. Kan. C-4409.

Static Test Group Engineer, degree, 25–45, three years' airframe or missiles experience, who is primarily concerned with structural testing of airplanes and component parts, meet structural compliance requirements and specifications of research nature to determine design allowables of materials. Possible travel. $5200–$9300. Employer will pay placement fee. Kan. C-4410.

Research and Development Engineer, graduate mechanical, to 45, at least five years' experience in developing home-laundry equipment or allied products; to be able to handle men, do product engineering, designing, and developing home-laundry appliances. Moving expenses paid. $8000–$10,000. Company will pay placement fee. Wis. C-4412.

Machine Designer, to 50, at least five years' experience in designing light and medium automatic special machinery such as packaging and similar equipment; to design and develop light and medium automatic production machinery, following through installation and making it work, for a bakery. $12,000–$15,000. Company will pay placement fee. Chicago. C-4413.

Superintendent, ME graduate, to 45, at least five years' experience in supervisory capacity of precision job shop and machine shop, for close-

tolerance work; to supervise all production activities. $12,500. Employer will pay placement fee. Chicago. C-4419.

Manufacturing Engineer, to 45, at least three years' experience in the design and manufacture of small electromechanical devices, knowledge of tooling and manufacturing small precision devices; to co-ordinate engineering, sales, and manufacture modifications to basic line of about 100 standard types to meet special customers' requirements, supervise refrigerating panel design and converting engineering design to production drawings and maintain engineering standards. $8000–$12,000. Employer will pay placement fee. Ind. C-4427.

Project Engineer, to 50, to create designs of electrical and mechanical nature, full responsibility for projects from conception to tooling and into production; furnishing information for specifications, processes, and sales catalogs. $7000–$11,000. Employer will pay placement fee. Ind. C-4428.

General Tooling Superintendent, 35–50, ten years' toolroom and tool-design experience. Will head up tool engineering, gage design, machine design, and toolroom. $8000–$9600. Employer will pay placement fee. Ind. C-4450.

Manager or Manufacturing Engineer, ME graduate, 38–50, 15 years' electrical or control experience; as department head. A knowledge of machine-tool design, and process engineering, industrial engineering, and tool engineering. Will head up all factory engineering; for manufacturer of heating and refrigerating controls. $10,000–$12,000. Employer will pay placement fee. Ind. C-4451.

Plant Engineer, mechanical or chemical graduate, to 35; at least three years' experience in plant-engineering work and in process industry. Duties will include general plant-engineering work in process industry; for manufacturer of chemicals. $7500. Fla. C-4473.

Staff Engineer, degree, 30–40, at least five years' experience in industrial engineering for manufacturer. A knowledge of incentives and time studies, for staff-engineering assignments on production problems. Some traveling. $11,000, plus expenses. Employer might negotiate fee. Headquarters, Chicago. C-4474.

Works Manager, degree, at least five years' experience as plant manager in plant with multiple processes and products and preferably in paper. A knowledge of over-all engineering and administration of all manufacturing functions; to do the initiation and administration of design, installation, and supervision for co-ordinating all line and staff manufacturing activities for several plants, for paper-manufacturing company. $10,000–$20,000. Chicago. C-4490.

Chemical Design and Development Engineer, ME graduate, five years' experience as engineer on light, fast-moving, automatic machinery, to supervise the installation and direction of all machine design and development activities; for manufacturer of paper products. $10,000–$20,000. Chicago. C-4492.

Plant Superintendent or Manager, ME, graduate, 30–50, five years' experience in fabricating stainless-steel parts. A knowledge of welding, polishing, and assembly; to take complete charge of plant operations, fabrication, assembly, welding, polishing, testing, shipping. Should have experience in dairy or food-handling equipment. $6000–$12,000. Employer will pay placement fee. Wis. C-4566.

Design Engineer, BS(ME), experience in switch gear for heavy power, for design, layout, and development of power circuit breakers and components. Hydraulic experience desirable. Salary open. San Francisco, Calif. S-235.

Candidates for Membership and Transfer in ASME

THE application of each of the candidates listed below is to be voted on after March 23, 1956, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the Secretary of The American Society of Mechanical Engineers immediately.

New Applications and ●Transfers

Alabama

DERIEUX, EUGENE T., Huntsville

California

ANDREW, WILBURN H., Los Angeles
●ANGSTADT, RICHARD R., Whittier
BAIRD, ANDREW G. M., Alhambra
BUITRAGO, EUGENIO, JR., Sunnyvale
CHOTI, STEVEN I., Los Angeles
FRANICH, MATTHEW H., Los Angeles
GILLILAND, HERMAN W., Reseda
IRWIN, J. F. CLARKE, Long Beach
KOVNAT, ROBERT, Los Angeles
LAFLEUR, JAMES K., Hermosa Beach
MANK, MARC, Oakland
MERRILL, AUSTIN H., Whittier
NIELSEN, MELVIN S., Pleasant Hill
POWELL, BRUCE E., El Sobrante
PRIAN, VASILY D., Hawthorne
STIPANOV, JEROME A., El Segundo
VAKIL, BHANUPRASAD M., Los Angeles
WILLIAMS, HOWARD J., Los Angeles
WINN, WILLIAM P., Los Angeles
ZILIMAN, JACK H., Redondo Beach
ZIMMERMAN, CLEMENT, Downey

Connecticut

HARSCH, WILLIAM E., Trumbull
THOMAS, WILLIAM A., Stratford

Delaware

REYNOLDS, PETER G., Wilmington

Florida

BROWNING, RUDOLPH M., Pensacola

Georgia

CARMICHAEL, ROBERT D., Hampton
GRAHAM, WILLIAM F., Newman

Idaho

DEMPSTER, JEAN L., Idaho Falls
WOOD, ROGER J., Idaho Falls

Illinois

DAVIS, RAYMOND W., Rockford
GOODALL, JOHN D., Elmhurst
LESSA, OTTO J., Chicago
●MADDEN, DEAN E., Decatur
SIEGEL, LESSING P., Chicago
WINSKELL, PAUL L., Morrison
ZANDROW, LEONARD F., Chicago

Indiana

●GIBBONS, JOSEPH P., Indianapolis
PATTEN, FRANKLIN L., Plainfield

Iowa

HANSON, JAMES C., Davenport

Kansas

●WOLFS, KARL E., Mission

Louisiana

DIEZ, WILLIAM, JR., New Orleans
ELAM, JOSEPH B., Shreveport
TINDAL, LORENZA V., Bastrop
WEIGERS, GORDON U., New Orleans

Maryland

CHAPMAN, PARKER O., Chevy Chase
GARMAN, ROBERT E., Baltimore
●KOEHLER, LOUIS A., JR., Baltimore
MCVAY, CECIL G., Hagerstown

Massachusetts

CILLEY, KENNETH D., Stoneham
HEIHL, JOHN J., Natick
●LAMMI, RAYMOND E., Danvers
LORENZETTI, VICTOR, Dedham
MCGAFFIGAN, JAMES H., JR., Medford
PORAZZO, JOHN A., Maynard

Michigan

BATES, RALPH B., JR., Detroit
DESILVA, CARL N., Ann Arbor
●HOMEISTER, ORVILLE E., Trenton
●MORRISON, HOWARD R., Grand Rapids
SLIPER, EARL G., Jackson

Minnesota

CALVA, JOSE B., Minneapolis

Missouri

HIGGINS, JAMES R., Kansas City

New Jersey

●MCGOWAN, FRANK K., Elizabeth
PETERS, KENNETH D., Rumson
●SOMERS, WILLIAM E., Newark
STEPANUK, WALTER, Newark
●WEISCOPF, CHARLES W., Plainfield

New Mexico

HALEY, JANO W., Los Alamos

New York

BARTU, ALLEN S., Schenectady
BREGGIN, ARNOLD H., Rochester
●BROTEN, PAUL R., Ithaca
DUSSLING, FRED A., Valley Stream
ENGEL, HOWARD D., New Hyde Park
HANSON, KENNETH L., Schenectady
●HEGETSCHWEILER, HEINRICH, Schenectady
JUDSON, GEORGE T., Whitney Point
●MATIUK, ALEXANDER, Freeport
O'DONNELL, JOHN R., Rome
ROWAN, WILLIAM T., Niagara Falls

North Carolina

PRONTAUT, LLOYD C., Charlotte

Ohio

BECKER, PERRY A., Toledo
BOYD, WILLIAM B., Cincinnati
CHOVAN, JOHN, JR., Massillon
COCUZZA, JOHN F., Maple Heights
HAWLEY, WILLIAM J., Vandalia
HAYWARD, LAURENCE W., Wadsworth
LEWIS, RICHARD J., Akron
LINDSEY, ROBERT J., Mt. Gilead
MADISON, ELVIN R., Alliance
MOSES, MORRIS G., Portsmouth
MURRAY, THOMAS E., Alliance
OELRICH, ROBERT L., Columbus
RIEMERSMA, COENRAAD E., Cincinnati
SHEFFA, CHARLES, Alliance
SPRY, LINDSAY E., JR., Doylestown
WOOD, JOHN R., Canton

Oklahoma

LACKEY, M. DUANE, Tulsa
LISLE, SAMUEL B., Oklahoma City
PASS, CHARLES D., Tulsa

Oregon

PACK, ANTHONY A., Beaverton
REIN, EDWARD N., Portland

Pennsylvania

BEAUDRY, JOHN M., Erie
●DELANEY, EDWARD F., Havertown
GEISER, JAMES W., Greensburg
HRADESKY, EDWARD L., Uniontown
O'GRADY, WILLIAM M., Philadelphia
PARKER, JOHN L., Merion Station
PERKINS, HENRY P., Pittsburgh
●SQUIRES, RICHARD, Gladwyne
THOMAS, DONALD D., Philadelphia

Rhode Island

BROWNELL, PETER, Providence
●DOWDELL, RODGER B., Providence
PFISTER, JOSEPH J., Providence

South Carolina

BEAUDROT, CHARLES R., Greenwood

Tennessee

●NEPERUD, WILSON F., South Pittsburg
WHITE, ROBERT J., Kingsport
●WINN, HOWARD R., Memphis
WOODRUFF, WILLIAM W., Chattanooga

Texas

BROWN, HOWARD E., Austin
FERSON, MALCOLM E., Dallas
●HOUSE, JOSEPH W., Port Neches
JUDY, ROBERT W., Dallas
LAUGHLIN, CHARLES D., Dallas

(ASME News continued on page 304)

● Transfer to Member or Affiliate.

this is "life insurance" for boilers

It's a good "policy" to protect your valuable boilers with YARWAY Boiler Level Indicators.

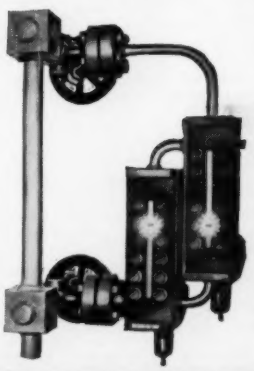
Instant . . . accurate . . . continuous remote readings of boiler water levels are available on the instrument panel or wherever you wish in the plant.

YARWAY's new "wide vision" face gives brilliant readings from any angle . . . and the pointer is always visible, even at extreme high and low water levels.

For brilliant "shines like a star" readings on the boiler drum you'll want to use YARWAY Flat Glass Gages with Type "M" Illuminators.

From drum to panel and at all remote locations, YARWAY equipment gives you the safest boiler protection you can buy—proved beyond doubt in nearly 10,000 installations.

Yarway Remote Liquid Level Indicator. Write for Yarway Bulletin WG-1824.



Yarway Flat Glass Water Gage with Type "M" Illuminators. Write for Yarway Bulletin WG-1812.

YARNALL-WARING COMPANY
108 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

YARWAY **steam plant equipment**

ROMEFELT, BIRCHIE W., JR., Lake Jackson
SNYDER, LENARD D., Dallas

Virginia

ADAMS, WILLIAM N., Charlottesville
BARLOW, EDSON L., JR., Williamsburg
●BISHOP, JOHN W., Alexandria
KRELLEN, HARRY I., Warwick
PROFFITT, WILLIAM L., Richmond
REINERTSON, JOSEPH H., McLean

Washington

BARDSLEY, GEORGE W., Seattle

Wisconsin

●LEITNER, GORDON F., Waukesha
●MEYER, JOHN R., Milwaukee
MOLIQUE, LEWIS J., Beloit
STEPHENS, JOHN L., West Allis
●TAINTER, LOWELL A., Port Washington
THIELE, CARL H., Milwaukee

Foreign

CAMPBELL, RONALD M., Montreal, P.Q., Can.
FLORES, ANACLETO G., Mexico City, Mex.
GARCIA-MORENO, V. C., JR., Mexico, D.F., Mex.
GEORGE, CHARLES M., Maracaibo, Venezuela, S. A.
●GUPTA, PITAM C., New Delhi, India
JAMES, RICHARD G., Kauai, T. H.
JAMIESON, JAMES, Glasgow, Scotland
KWATRA, AJIT S., Rangoon, Burma
NAIK, MANJALBAIL K., Bombay, India
SMALLRIDGE, COLIN G., Montreal, P.Q., Can.
TRICKETT, KENNETH A., Oshawa, Ont., Can.
TURNER, TREVOR, Cheshire, England
VISANUVIMOL, VICHAI, Bangkok, Thailand

Transfers from Student Member to Associate Member 100

Obituaries

Eustace Ezra Blundell (1878–1955), president and general manager, Commercial Centerless Grinding Co., Cleveland, Ohio, died Nov. 11, 1955. Born Guelph, Ontario, Can., July 15, 1878. Parents, Richard B. and Sarah (Thomas) Blundell. Education, attended Central High School, Cleveland, Ohio. Married Ella Stritmater, 1904; one daughter, Edith Ella. Assoc. Mem. ASME, 1917; Mem. ASME, 1935. Served as chairman of Program Committee for Cleveland Section ASME.

Lewis Remington Burdick (1900–1955), senior fuels engineer, Bureau of Mines, U. S. Department of Interior, Washington, D. C., died Oct. 13, 1955. Born, Independence, N. Y., Dec. 29, 1900. Parents, William L. and Flora G. Burdick. Education, BS(ME), Syracuse University, 1923. Married Florence Watson, 1927. Author of numerous technical papers. Mem. ASME, 1936. Survived by wife; two daughters, Mrs. William H. Dillingham, 3rd, and Mrs. E. Thomas Fish; two sisters, Mrs. Paul E. Saunders and Edith M. Burdick; and a granddaughter, Anne Leslie Dillingham.

John N. Chester (1864–1955), senior partner, The Chester Engineers, Pittsburgh, Pa., died Nov. 1, 1955. Born, Groveport, Ohio, Sept. 24, 1864. Education, BS, University of Illinois, 1891. Mem. ASME, 1905.

Chauncey H. Crawford (1879–1955), retired former general consultant, J. G. White Engineering Corp., New York, N. Y., died May 9, 1955. Born, Huntington, W. Va., June 27, 1879. Education, BS, Earlham College, 1897; BS, Massachusetts Institute of Technology, 1909. Mem. ASME, 1916.

Gordon Dabney Hardin (1900–1955), manufacturers' representative, Louisville, Ky., died Aug. 1, 1955. Born, Louisville, Ky., Oct. 25, 1900. Parents, Rowan and Anna (Allen) Hardin. Education, BS, Cornell University, 1924. Held patent on twist-drill point grinder, 1937. Mem. ASME, 1950.

Franklin Warren Hobbs (1868–1955), chairman, William Whitman Co., Boston, Mass., died June 16, 1955. Born, Boston, Mass., Sept. 24, 1868. Parents, William and Mary (Cogswell) Hobbs. Education, BS, Massachusetts Institute of Technology, 1889; Bradford Textile College, Bradford, England, 1891. Married Jane Whitman, 1892 (deceased), children: William, Marland, Franklin, and Rebekah. Received honorary MS degree, Dartmouth College, 1913; DS, Middlebury College, 1942; D Textile Sc., University of South Carolina, 1948. Mem. ASME, 1911.

Ely Champion Hutchinson (1882–1955), retired industrial executive and engineer, died from a heart ailment in Washington, D. C., on Nov. 12, 1955. Born, San Francisco, Calif., Feb. 10, 1882. Parents, Frederick W. and Helen (Cass) Hutchinson. Education, attended high school and studied mechanical engineering by correspondence courses. Married Florence A. Grant in 1906. He held many patents in the hydraulic power and mining fields. He was the author of numerous papers on steam hydraulics and other technical subjects. During World War II and for some years following he devoted himself largely to governmental and public service in technical and scientific affairs. Mem. ASME, 1912; Fellow ASME, 1936. Mr. Hutchinson served the Society as vice-president from 1933–1935. He was chairman of San Francisco Section, ASME. He had been president of the Engineers' Club of San Francisco. He was chairman and co-organizer of Engineers' Employment Service in San Francisco. From 1928–1931 he was a manager of ASME. He was chairman and co-organizer of Hydraulic Power Professional Division, ASME; Pure Air Committee, ASME; and Power Test Code Committee No. 18, Hydraulic Prime Movers, ASME. He served the Society as chairman of the following: Meetings and Program Committee, Engineers' National Relief Fund, American Boiler Manufacturers' Association Committee, and New York Committee of the Third World Power Conference. He was president of Class One Welding Association of U. S. He belonged to the Standing Committee Power Test Codes, ASME. He was a member of the Advisory Board, National Hydraulic Laboratory, U. S. Bureau of Standards, Washington, D. C. The U. S. State Department accredited him to be a delegate to Second World Power Conference, Berlin, Germany. He was director secretariat of U. S. National Committee, International Electro-Technical Commission on Hydraulics. In April, 1940, he directed the first participation by industry in the New York Army Day parade. During the past few years Mr. Hutchinson had been living in retirement at his home in Washington, D. C. He is survived by his wife and a daughter, Mrs. Henry C. Alexander, New York, N. Y.

Emory Neudeck Kemler (1906–1955), professor of mechanical engineering and head of machine-design and instrumentation division of the Institute of Technology, University of Minnesota, died Dec., 1955. Born, Basehor, Kan., July 21, 1906. Parents, Elmer F. and Theresa M. Kemler. Education, BE(ME), University of Kansas, 1927; ME, University of Kansas, 1932; MS, University of Pittsburgh, 1931; PhD, University of Pittsburgh, 1934. Married Doris McCabe, 1931; two children, Nancy and Emory N., Jr. Held 16 patents on heat-pump and well-weighing devices. Published over 160 papers and articles in machine-design, petroleum-production, and fluid-flow fields. Coauthor of books on "Elements of Mechanical Vibrations," 1943 and 1949; and "Aircraft Vibration and Flutter," 1944. Jun. ASME, 1927; Assoc. Mem. ASME, 1933; Mem. ASME, 1935; Fellow ASME, 1953. Past-chairman of Midcontinent Section, Minnesota Section, and Petroleum Division.

Michael Joannes Krene (1914–1955), assistant plant engineer, Pittsburgh Works, Continental Foundry and Machine Co., Pittsburgh, Pa., died in June, 1955. Born, Butler, Pa., July 22, 1914. Education, BS(ME), Carnegie Institute of Technology, 1954. Assoc. Mem. ASME, 1954.

Judson Lattin (1863–1955), retired mechanical engineer, died Oct. 26, 1955. Born, DeKalb, Ill., Feb. 27, 1863. Parents, Nathan and Mary (Bemis) Lattin. Education, BS, University of Illinois, 1885. Married Fannie Thomas, 1888; four children, Judson, Jr., Elsie, Robert, and Mary Lattin. Mem. ASME, 1891.

Charles Ellis Lehr (1873–1955), retired chief engineer, Bethlehem Steel Company, Bethlehem, Pa., died Aug. 31, 1955. Born, Bucks County, Pa., April 18, 1873. Parents, John and Adeline Lehr. Education, self-educated. Married Celesta Diefeudeifer, 1892; two sons, Harold and Charles Ellis. Author of numerous papers on rolling-mill practice-flow sheets. Mem. ASME, 1916; Fellow ASME, 1949.

Horace Preston Liversidge (1878–1955), chairman of the board, Philadelphia Electric Co., died Dec. 8, 1955. Born, Norristown, Pa., Sept. 28, 1878. Parents, Thomas S. and Elizabeth (Preston) Liversidge. Education, Drexel Institute of Technology, 1897. Married Sara B. Moore, 1902. Author of numerous articles on technical and other subjects. Received William Penn Award of Greater Philadelphia Chamber of Commerce, 1952. Received the James H. McGraw Award for co-operation in electrical industry, 1932. Received Pioneers of Industry Award, 1944. First recipient of The Edward Powell Fund Award, 1951. Received Human Relations Award of National Conference of Christians and Jews, 1955. Held patents on improvements in cable potheads, disconnecting switches, bus-bar supports, and other power-station equipment. Mem. ASME, 1917; Fellow ASME, 1937. Chairman, Philadelphia Section ASME, 1916-1917. Member, board of managers, ASME, 1921–1924. He was a member of the board of directors, The Engineers' Club of Philadelphia, 1923–1926. Survived by wife; three sons, Preston M., Robert P., and Thomas K. Liversidge.

Frank Sergeant Manning, Jr. (1922–1955), president, Manning Engineering Corp., Louisville, Ky., died in a plane crash in November, 1955. Born, Atlanta, Ga., June 5, 1922. Parents, Mr. and Mrs. Frank S. Manning. Education, BS(ME), Mississippi State College, 1948. Married Marybelle Manning. Jun. ASME, 1948. Survived by wife, parents, and a sister, Mrs. Edgar Wilkins.

Thomas Canning McBride (1868–1955), retired inventor and engineer, Worthington Pump and Machinery Corp., Philadelphia, Pa., died Nov. 23, 1955. Born, Philadelphia, Pa., March 31, 1868. Parents, William J. and Elizabeth (Canning) McBride. Education, BS, University of Pennsylvania, 1888; ME, University of Pennsylvania, 1889. Married Sally Neals, 1901. Invented folded tube layer, surface condenser, and locomotive feedwater heater. Received Longstreth Award for Inventions, The Franklin Institute, 1917. Awarded John Scott Medal by City of Philadelphia, 1928. Awarded Franklin Medal, The Franklin Institute, 1936. Cited by American Manufacturers as pioneer inventor, 1940. Author of study, "Air Leakage in Steam Condensers," 1917. Mem. ASME, 1908; Fellow ASME, 1949. President, Philadelphia Engineers' Club, 1900–1907. Chairman, Railroad Division ASME, 1927–1932. Survived by wife; a daughter, Dr. Katherine E. McBride; a son, Thomas C. McBride, Jr., and two grandchildren.

William McCoy (1878–1955), retired, died Sept. 20, 1955, in Canton, Ohio. Born, Zanesville, Ohio, April 26, 1878. Parents, Wilbur I. and Cornelia McCoy. Education, attended Zanesville High School. Jun. ASME, 1903; Mem. ASME, 1925. Survived by wife, the former Louise Bauer; and a son, William B. McCoy, Canton, Ohio.

Donald Godfrey Merrill (1896–1954), development engineer, Emhart Manufacturing Co., Hartford, Conn., died Jan. 25, 1954. Born, Taunton, Mass., Jan. 4, 1896. Parents, Walter A. and Anna (Godfrey) Merrill. Education, BS, Massachusetts Institute of Technology, 1918; BS, Harvard University, 1918. Married Ruth Meader, 1939. Jun. ASME, 1919. Survived by wife; four children, David B., Elizabeth, Janice, and Mrs. Judith M. Contompasis, Winchester, Mass.

Bernard Stanley Nelson (1888–1955), retired vice-president in charge of engineering, A. M. Lockett & Co., New Orleans, La., died Oct. 19, 1955. Born, New Orleans, La., Aug. 28, 1888. Parents, Gustave R. and Louise (Courtin) Nelson. Education, BS(ME), Tulane University, 1907. Married Mary Hutson, 1913. Held patents on oil burner, oil heater, creosote plant condenser, spray nozzle, and high-pressure grease gun. Author of numerous technical articles. Jun. ASME, 1910; Assoc-Mem. ASME, 1917; Mem. ASME, 1922. A member of the Louisiana Engineering Society, he was appointed to the group's board of directors for two-year terms in 1921 and 1938. He was first vice-president of the society in 1940 and served on many of the organization's committees and in other activities during his membership. Survived by wife; two sons, Waldemar S. and Thomas H.; two daughters, Mary and Mrs. J. P. Ewin, Jr.; a brother, Lawrence K.; and a sister, Mrs. M. B. Hutson.

Frank Edward Payne (1883–1955), chairman of the board and cofounder, Crane Packing Co., Chicago, Ill., died Nov. 20, 1955, at his home in Glencoe, Ill. Born, Charleston, Mass., Jan. 27, 1883. Parents, George W. and Caroline Rae Payne. Education, BS, Massachusetts Institute of Technology, 1905. Married Seba Burnham. Mem. ASME, 1922. Survived by wife and a daughter, Mrs. George A. Hurd, Bethlehem, Pa.

(ASME News continued on page 306)

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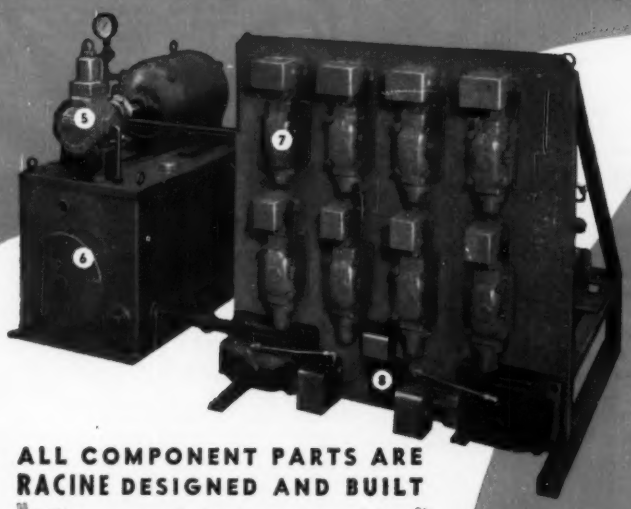

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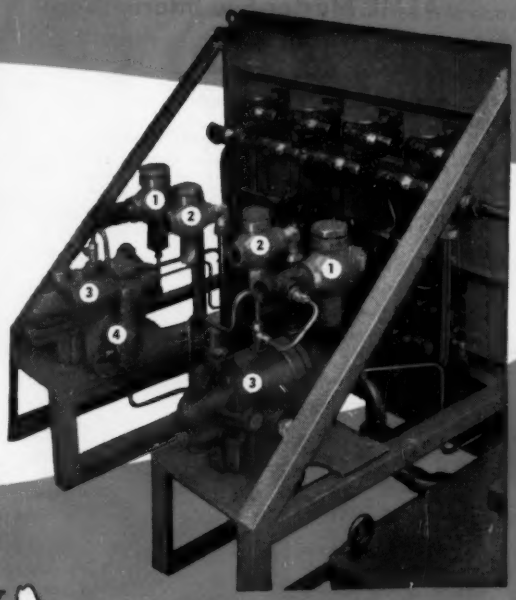

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Achilles Henry Pugh (1876–1954), president, A. H. Pugh Printing Co., Cincinnati, Ohio, died March 25, 1954. Born, Cincinnati, Ohio, March 13, 1876. Parents, Achilles H. and Mary L. (Darr) Pugh. Education, BS(ChE), Massachusetts Institute of Technology, 1897. Married Elizabeth Worthington, 1913; children, Mrs. Elizabeth (Samuel I.) Crew, A. Henry, 4th, Louise, and William W. Developed original method of working compass alone to work out any geometrical problem possible with ruler and compass. Assoc-Mem. ASME, 1916. From 1918 to 1920 he was head of Loading and Explosive Section, Cincinnati Ordnance District and member of the Claims Board settling contracts terminated by Armistice.

Walter Frank Rittman (1883–1955), whose death was recently reported to the Society, was a practicing consulting engineer in Pittsburgh, Pa. Born, Sandusky, Ohio, Dec. 2, 1883. Parents, Christian A. and Louisa A. (Scheel) Rittman. Education, CE, Ohio Northern University, 1905; AB, Swarthmore College, 1908; MA, 1909; ME, 1911; ChE, 1917; PhD, Columbia University, 1914. Married Anna Campbell, 1913; children, Frank S., William C., and Eleanor A. Author of numerous articles dealing with application of physical chemistry to industrial processes. Mem. ASME, 1919.

Ellsworth Walters Smith (1921–1955), project engineer, E. I. du Pont de Nemours & Co., Inc., Aiken, S. C., died Oct. 1, 1955. Born, Union Bridge, Md., Jan. 5, 1921. Parents, Roland E. and Catheryn J. Smith. Education, BS(ME), University of South Carolina, 1952. Married Elizabeth Adelia Blalock, 1944. Assoc. Mem. ASME, 1955. Survived by wife, his mother, and daughter, Catheryn J.

Henry Sidney Smith (1873–1954), consulting engineer, The Linde Air Products Co., New York, N. Y., died May 14, 1954. Born, Newark on Trent, England, Nov. 3, 1873. Parents, Henry R. and Anne (Bradley) Smith. Education, ME, Nottingham University, England, 1893. Married Rida Marie Rein, 1916. Mem. ASME, 1919. Recipient of the James Turner Morehead Medal, 1936; the Samuel Wylie Miller Memorial Medal, 1936; and numerous certificates for loyal services and achievements. Survived by wife.

William Shallcross Speed (1873–1955), chairman of the board, Louisville Cement Co., Louisville, Ky., died Dec. 8, 1955. Born, Louisville, Ky., Sept. 10, 1873. Parents, James B. and Cora A. (Coffin) Speed. Education, BS, Rose Polytechnic Institute, 1895; MS, 1897; ME, 1899; honorary DE, Rose Polytechnic, 1933; DS, University of Louisville, 1950. Married Virginia Perrin, 1904; children, Mrs. Alice S. (Berry V.) Stoll and Virginia H. Assoc-Mem. ASME, 1900; Mem. ASME, 1904. Formerly a trustee of the University of Louisville for 25 years, Mr. Speed and his sister, the late Mrs. Frederic Speed Sackett, endowed the Speed Scientific School at the university in 1925 in memory of their father, James Breckinridge Speed. In October, 1955, he presented to the university another $75,000 gift and pledged an additional $375,000 toward a building to house the civil and electrical-engineering departments of the Speed Scientific School.

Joseph S. Wilcox, Jr., (1887–1955?), whose death was recently reported to the Society, was a retired engineer of Stamford, Conn. Born, Jersey City, N. J., Oct. 5, 1887. Education, attended Union College for two years. Mem. ASME, 1942.

Alexander Hardie Wilson (1882–1955), chief engineer, Thomas Hoist Co., Chicago, Ill., died in January, 1955. Born, Edinburgh, Scotland, April 21, 1882. Parents, William A. and Mary (Hardie) Wilson. Education, ME, American School of Correspondence, 1918. Naturalized U. S. citizen. Married Elizabeth Meiser, 1907; son, William John. Held several U. S. Patents pertaining to hoisting machines, automatic control for hoisting machines, clutch operating means, portable hoisting machines, safety devices for elevators, and safety brakes. Author of numerous technical papers. Assoc-Mem. ASME, 1918; Mem. ASME, 1935.

Samuel S. Wyer (1879–1955), consulting engineer, Columbus, Ohio, died Nov. 30, 1955. Born, Wayne County, Ohio, Feb. 18, 1879. Parents, David and Katherine (Eicher) Wyer. Education, ME, Ohio State University, 1903. Married Pauline Conover, 1904; children, Jean W. Meyer, Neal, and Ramon. Married 2nd, Eva Armstrong, 1926. Author of book, "Living Together in a Power Age," many technical papers, and more than 200 professional reports dealing with corporation problems. Jun. ASME, 1904; Mem. ASME, 1911. In 1920, as consulting engineer for Secretary of the Interior Lane, he prepared the first pooling program for field operation for oil and natural gas. In 1924 and 1925, in private practice, he made an exhaustive study of the electric-power situation in the eastern part of the United States and Canada, extending from Muscle Shoals, Ala., to Montreal, Que., Can. During World War II he was chief of the natural-gas conservation activities of the United States Government. Survived by wife; two sons, Ramon, Louisville, Ky., and Neal, Tarrytown, N. Y.; a sister, Mrs. Katie Shetler, Rittman, Ohio; and eight grandchildren.

Keep Your ASME Records Up to Date

ASME Secretary's office in New York depends on a master membership file to maintain contact with individual members. This file is referred to dozens of times every day as a source of information important to the Society and to the members involved. All other Society records and files are kept up to date by incorporating in them changes made in the master file.

From the master file are made the lists of members registered in the Professional Divisions. Many Divisions issue newsletters, notices of meetings, and other materials of specific interest to persons registered in these Divisions. If you wish to receive such information, you should be registered in the Divisions (no more than three) in which you are interested. Your membership card bears key letters opposite your address which indicate the Divisions in which you are registered. Consult the form on this page for the meaning of the letters. If you wish to change the Divisions in which you are registered, please notify the Secretary's office.

It is important to you and to the Society to be sure that your latest mailing address, business connection, and Professional Divisions' enrollment are correct. Please check whether you wish mail sent to home or office address.

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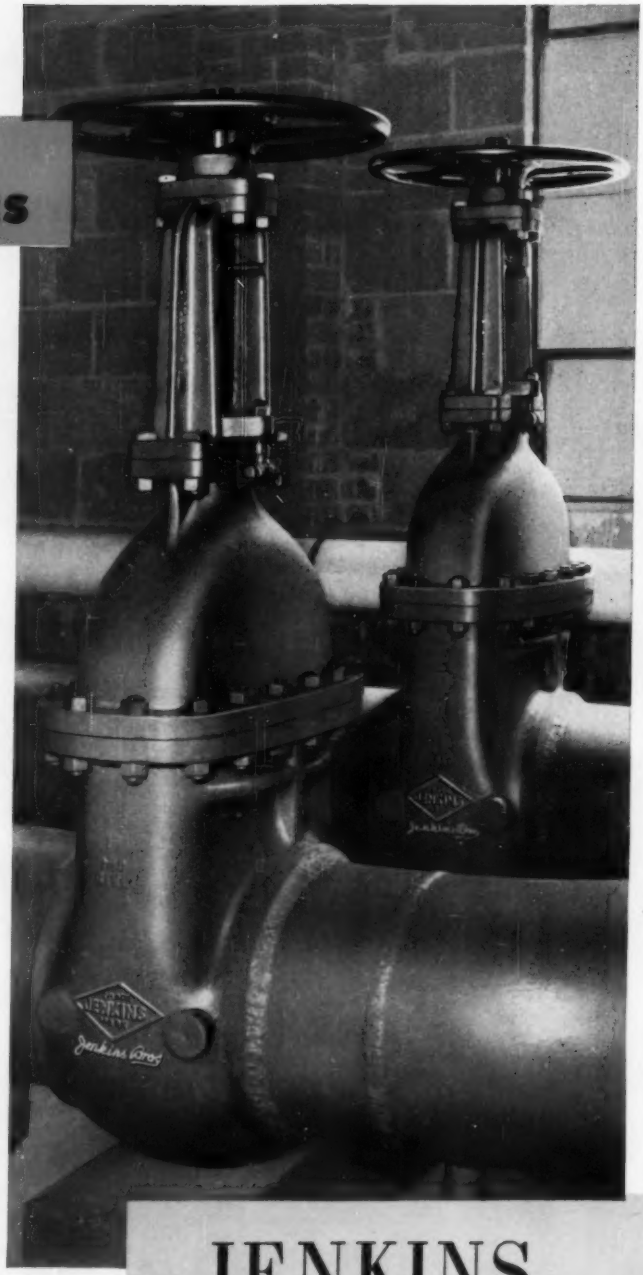

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NEW EQUIPMENT

Dual Drive Adapter

F. W. Stewart Corp., 4311 Ravenswood Ave., Chicago 13, Ill. has perfected a "Circle Ess" dual drive adapter which is used in conjunction with flexible shaft drives where more than one unit is to be driven from the same power source.

It provides two gear ratios of power drives from the same power source. These adapters are equipped with threaded connections having .104 in. internal square drives and in ratios of 1 to 1, 15 to 1, 16 to 1, and 17 to 1 for either left or right rotation.

The body is made of aluminum alloy with brass connectors and the hardened steel gears run in oil-lite bearings which are permanently lubricated for high and low temperatures. Weight is 4 oz.

Noise Attenuator

A new 4-44 Series pneumatic noise attenuator has been developed by the Allied Witan Co., Box 2770, Cleveland 11, Ohio.

The unit features an internal resonator, a new air diffuser having a larger exhaust radiation area with 250 per cent greater air flow capacity, the firm states.

The new Atomuffler when connected to the exhaust port of air-operated equipment is said to eliminate 99.9 per cent of the objectionable exhaust noise of air-operated equipment. Injurious exhaust loudness is completely eliminated because it stops noise at its source.

The new model is available in eight pipe sizes ranging from $^1/_8$ to 2 in., NPT. The units are made with a male pipe thread for direct connection to the exhaust port of air-operated equipment.

Drafting System

Universal Drafting Machine Corp., 7960 Lorain Ave., Cleveland 2, Ohio, is now producing what is said to be the world's first complete, portable drafting system of professional quality, yet designed and priced for personal use. It is specially recommended by the company for anyone requiring accuracy in design, sketches, layouts, forms and drawings.

The unit features a personal size professional drafting machine, complete with folding drawing board, accurate metal scales, instrument box and carrying carton or custom-built travel case. Desk-Topper operates easily on a desk or standard table. All items store compactly in an average desk drawer or cabinet.

The unit can be set up or put away in two minutes time, with all drawing tools immediately at hand. The drafting machine provides a drawing capacity of 22 × 34 in., while the folding drawing board accommodates designs up to 17 × 22 in. The drafting machine may be used with or without the drawing board.

Features include 360 deg protractor, automatic 15 deg indexing, full baseline selector. A range of scale graduations are available for varied needs, including elite and pica typewriter spacing for business forms and office work, as well as scales for blueprints, design and engineering.

Instrument Base Plates

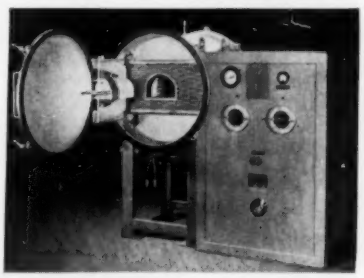
Allied Products Div., Hamilton Watch Co., Lancaster, Pa., announces that it is now in commercial production of precision structural mounting elements or base plates for small precision mechanisms.

These structural elements or base plates are produced by special manufacturing methods and facilities developed by Hamilton for producing the base or "pillar" plates of watches.

Dust-Spot Tester

Research Appliance Co., Pittsburgh, Pa., is now manufacturing the Dill dust-spot tester, which is used to measure accurately the efficiency of all types of air filters in ventilating systems. This tester has been in use for many years and has been commonly known as the "U. S. Bureau of Standards Discoloration Test," "National Bureau of Standards Dust-Spot Test," or "Bureau of Standards Blackness Test."

It is a portable unit that makes rapid, accurate determinations at the point of installation. Actual atmospheric contamination is used as the basis of the test; artificial test dusts do not have to be introduced into the system.



Vacuum Furnace

A high temperature vacuum furnace has been announced by the Harper Electric Furnace Corp., Buffalo, N. Y. It was designed primarily as a research or small production furnace for heating ceramic and metallic parts in a vacuum of 200 to 300 μ at temperatures up to 2500 F.

The furnace illustrated has a D-shaped muffle with a chamber $7^1/_2$ in. wide, 13 in. deep and 5 in. high. Heat is produced by resistance heating elements, which are placed around the muffle.

The firm says other features of the new furnace are: ability to obtain a high vacuum in a few minutes for firing material to be placed in a hot furnace and heated under a vacuum; ease of access to the furnace through the use of a removable end bell and a hinged plug refractory door; compact assembly of furnace, pumping equipment and electric controls.

The new electric vacuum furnaces are available in larger sizes and with modifications for lower and higher temperatures for various processes.

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Electric Fan Clutch

Warner Electric Brake & Clutch Co., Beloit, Wis., has announced the development of a new low-cost electric fan clutch unit for internal combustion engines. Applications include automobiles, trucks and busses, tractors and farm implements, construction equipment marine applications and amphibious vehicles, and portable power units.

The company says the unit is being brought to the market because of a need for a practical, low-cost system of fan control to eliminate power loss and excessive fuel consumption said to be characteristic of present day cooling fans. It has been estimated that approximately 8 to 12 hp are needed to drive the fan on today's passenger car, and that heavy-duty engines may need as much as 22 hp to drive the fan, the firm states.

According to the company, it has long been known that a cooling fan need not operate 100 per cent of the time when an internal combustion engine is running; the fan is required principally for cooling the engine during hot weather and when the engine is under heavy load.

Application of the firm's stationary-field electro-magnetic clutch to the internal combustion engine is said to have resulted in such advantages as fuel and horsepower savings ranging to 10 per cent; faster warm-up and more efficient operating temperatures; noise reduction and increased driving pleasure; reduction of sludging in engine oil; improved over-all engine performance and efficiency, and longer engine life; in bus operation, stabilized engine cooling provides increased vehicle heating system efficiency; low cost of the unit; simplicity of the electric system as compared with air or hydraulic actuation.

Operation of the unit is said to be relatively simple and it may be adapted equally well to engines which carry the fan and water pump on the same shaft driven by a common pulley, or to engines on which the fan is separate from the water pump. A typical application utilizes a Warner electric clutch of stationary-field design. In such as this, the field is mounted on the water pump housing. The sheave and rotor are fastened together and mounted in such a way as to drive the shaft continuously. In this way the water pump impeller rotates constantly. A hub is mounted on bearings in front of the rotor with an armature fixed to the hub with leaf springs so that it runs normally with a small clearance between its face and the rotor face. The fan is bolted to the front of the hub. When the coil is energized, magnetic pull at the rotor pole faces attracts the armature and holds it to the rotating rotor. The hub and fan are then driven with the pulley. This clutch is generally set up so that a thermostatic switch may be used to control it. This thermostat is then located so it can be actuated by a change in temperature of the water system in order to cycle the fan clutch on and off as required. Tests

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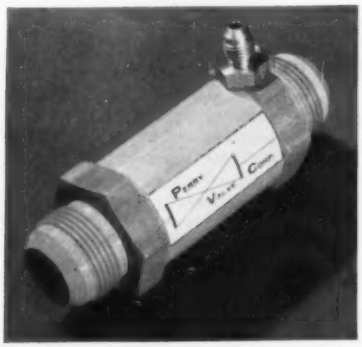
NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

have indicated that on days when the outside temperature is below 50 F, the fan is never needed even for slow city driving. Highway tests at an average speed of 40 mph show that when the outside temperature is above 90 F, the fan engages only about 40 per cent of the time.

The extremely wide variations in engine design make it necessary to design a fan clutch for each engine in order to meet specific requirements of space, mounting, pulley dimensions, torque, etc. Information on specific application arrangements may be obtained from the company.



Shut-off Valve

Perry Valve Corp., Dover, N. J., introduces its new Model AV all purpose shut-off valve of original design.

According to the company, the model has but one moving part and features simple, compact, lightweight construction for long term reliable performance. The Model AV-1000 valve pictured above for 1-in. tubing is 5 in. long overall, weighs 1 lb and will handle a flow of 50 gpm at a 50 psi pressure drop..

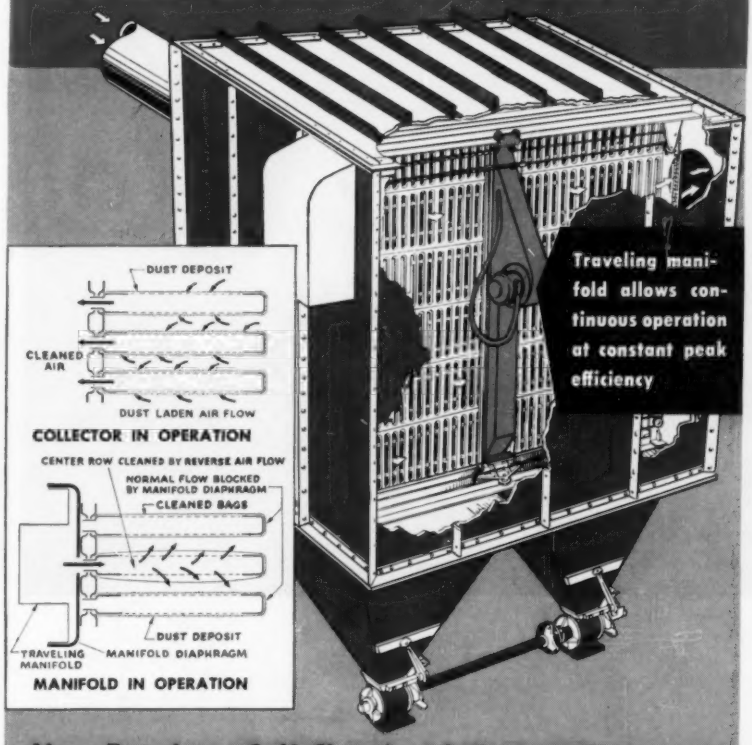
Maximum working pressure of the valve is 3000 psig and the required piloting control pressure is equal to the working pressure. Special stainless steel construction is available for highly corrosive liquids or vapors.

Oscillograph

A new oscillograph featuring operating convenience has been introduced by the Hathaway Instrument Co., 1315 S. Clarkson St., Denver 10, Colo. Known as the Hathaway S25 Oscillograph, this new instrument features: 12 chart speeds from $^1/_{16}$ to 160 ips; speed changes possible during operation; timing line intervals from one to $^1/_{1000}$ second are automatically controlled by chart speed or selected manually; and the galvanometer trace zero adjustment is featured on an easy-to-use sloping top panel.

Remote control operation of the Hathaway S25 is possible from distances up to 100 ft by means of the removable control panel. The S25 is available with up to 14 bifilar galvanometers or 36 pencil type coil galvanometers of new design.

NOW! Great news about a NEW Pangborn Dust Collector that MAINTAINS CONSTANT OPERATING EFFICIENCY



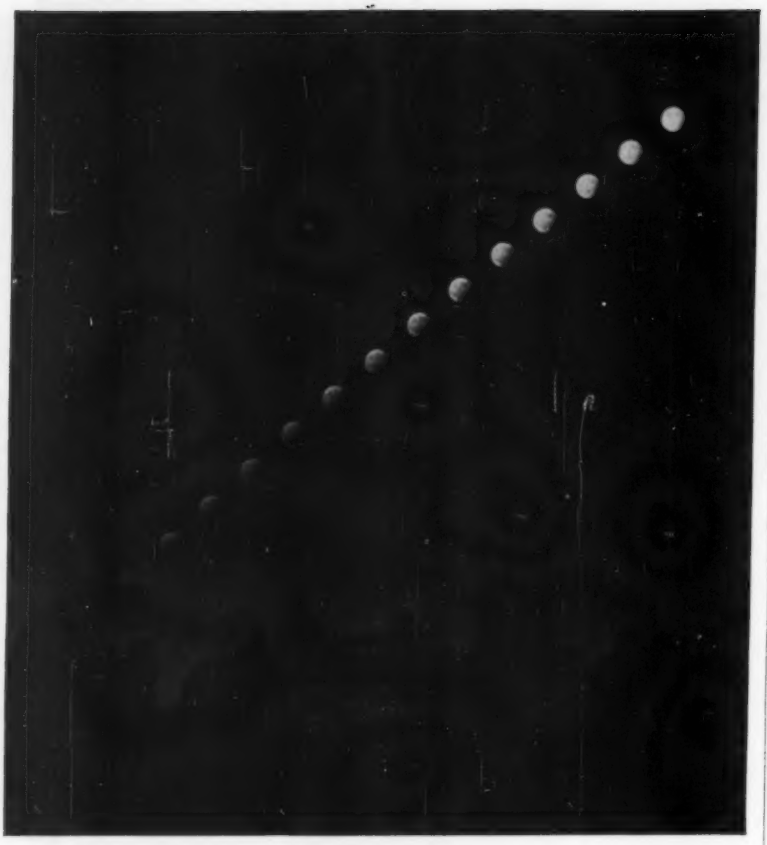
New Pangborn Self-Cleaning Collector offers continuous automatic operation, constant air volume and suction, uniform air flow resistance at low cost.

TO MAINTAIN constant efficiency, the Pangborn Self-Cleaning Collector combines the proved efficiency of the cloth screen collector with continuous automatic operation.

A manifold with integral blower slowly traverses the clean air outlets of the screen frames. Covering three rows of screens at any given time, it applies a reverse air current through the center row to remove collected dust from the cloth surfaces. The result is constant high collecting efficiency and continuous operation—shutdown of the system for periodic cleaning is eliminated. Because of design simplicity and unit construction, this unique collector requires lower initial, operating and maintenance costs as well as less floor space than comparable collectors.

For full details, write for Bulletin 915 to PANGBORN CORP., 2200 Pangborn Blvd., Hagerstown, Md.

Pangborn CONTROLS DUST



many moons

Less than 5,000 working hours from now, Martin will launch the world's first earth satellite. As with the famed Martin Viking Rocket program, this is to be No. 1 of a continuing series of astronautical research vehicles – man-made moons which will chart the way toward the conquest of the final frontier, space itself.

If you are interested in the greatest engineering adventure of our time, contact J. M. Hollyday, ME-03, The Martin Company, Baltimore 3, Maryland.

MARTIN
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Shaft Collars

A new line of shaft collars available in 44 bore sizes from $^{3}/_{16}$ to 3 in. in $^{1}/_{16}$-in. increments is announced by Climax Metal Products Co., 863 East 140 St., Cleveland 10, Ohio. The new collars, equipped with precision, cup-point socket set-screws, are designed to hold shafts mounted on plain bearings in position, eliminating "floating."

In sizes up to 2 in., the collars are machined from cold rolled steel with cadmium finish. The larger sizes are machined from cast iron with machinery gray lacquer finish. All collars, the manufacturer states, are machined with chamfered inside and outside corners and are precision bored. Collars are shipped with set-screws assembled.

The new collars are said to provide designing convenience of a standardized part that can be employed on almost any shaft requiring thrust control from record players and blowers to textile machinery.

The collars are uniformly packaged in 5 to 50-piece quantities, depending upon size, and are clearly labeled for stocking.

A-C Power Transformer

Jack & Heintz, Inc., 17600 Broadway, Cleveland 1, Ohio, designer and manufacturer of electric accessories for aircraft and missiles, announces that it is adding power transformers as a product line.

The company says this is another step in strengthening its position as a prime supplier of complete a-c and d-c systems for high-performance military and commercial aircraft. The a-c and d-c primary power system components now include generators, control panels, regulators, circuit breakers, transformers, inverters, converters, and special devices. These components are available separately or are specially "matched" and integrated into complete systems to meet any specific power requirements up to 160 kva.

First of the new transformer line is the Wye-to-Delta GC150 for conversion of three phase a-c power from 200 v, line-line, to 115 v, line-line. This transformer has passed all qualification tests and is now in service on the Boeing B47 and the MD-3 ground power supply units.

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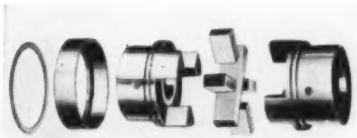
NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS



Flexible Coupling

A new radially removable flexible coupling that is said to provide extremely easy assembly and disassembly is now being manufactured by Lovejoy Flexible Coupling Co., 4832 W. Lake St., Chicago 44, Ill. The unit is lubrication-free and is especially suited to centrifugal and impeller pumps and other installations where radial removability is required.

Six sizes are available, ranging from 2.58 to 29.6 hp at 100 rpm. All feature reversible cushions so that the cushions can be reversed on unidirectional loads to double their service life.

The radial removability is accomplished by special cushions cut so they are held in position by a standard "C" collar when the coupling is assembled. When the collar is removed the cushions can be removed. This allows the coupling half and connected shaft to be rotated so that the intermeshing jaws slide into the stationary coupling half which is not removed. Disassembly is similarly accomplished.

In-Line Relief Valves

James-Pond-Clark, 2181 E. Foothill Blvd., Pasadena 8, Calif., announces an innovation to its Circle Seal 5100 series in-line relief valves: an $^1/_8$ in. pipe size.

The recent addition, available is brass or steel for pressures from 50 to 1000 psi. is added to the standard 5100 series line which includes $^1/_4$, $^3/_8$, $^1/_2$, $^3/_4$, and 1 in. pipe sizes with male inlet and female outlet. The company says the relief pressure, which is adjustable internally, is tamperproof when the valve is installed. The $^1/_8$ in. relief valve is said to be suitable for use with test bench equipment to prevent over pressurization on equipment, small pumps, and gages; for use with block valves to provide thermal relief; for use in place of frangible disks on high pressure container to provide thermal relief and relief from over pressurization.

The performance curve of the valve series shows a slight but regular increase in pressure drop with increasing flow rate which serves to stabilize the action and impart smooth, quiet, chatter-free operation, the firm states.

An O-ring seal and a spring centering device which allows only axial force to be transmitted to the poppet are features of the valve. The company says the valve exhibits no leakage within as little as 2 per cent of the pre-set cracking pressure and re-seats with no leakage within as close as 5 per cent of the setting.

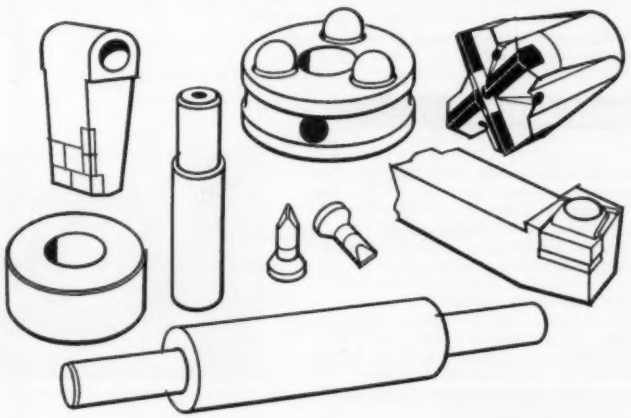
When compressive strength is important . . . look to KENNAMETAL*

The high compressive strength of Kennametal tungsten carbide compositions offers an unusual physical property to designers in that it is higher than that found in virtually all melted, cast or forged metals and alloys. It is as high as 800,000 psi.

In addition, Kennametal offers high hardness (85.0 to 93.0 Rockwell A); an extremely high Young's Modulus of Elasticity (as much as 94,300,000 psi); exceptional wear properties (as high as 100 to 1 as compared with steel); plus high impact strength and unusually high resistance to abrasion.

Where retention of compressive strength at high temperatures presents a problem, Kentanium* may be the solution. Kentanium titanium carbide compositions combine high compressive strength and resistance to oxidation and thermal shock at temperatures of 1800°F. and above.

With this combination of physical properties, Kennametal and Kentanium are providing unusual performance in such diverse applications as rolls for cold rolling of steel, dies, hammers and rams, mortars and pestles, testing machine parts (such as Brinell testing hammers), balls and seats for pumps, rock and core bits (for percussion drilling of hard rock and metal ores), milling and interrupted cutting of steels, hot rod-mill guides, and compression blocks for high temperature testing of alloys.



What is your problem? As Kennametal is made in many grades, each with a high compressive strength, you can select the right grade for a specific problem. Kennametal may be the answer in getting your idea from the drawing board into production. Why not discuss your problem with a Kennametal engineer? He can show you reports of Kennametal performance on scores of applications and help you apply the grade best suited for your purpose. For more information, write for Booklet B-111. KENNAMETAL INC., Dept. MS, Latrobe, Pa.

*Registered Trademark

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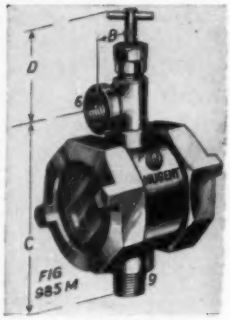
DESIGN AUTOMATIC POSITIVE LUBRICATION INTO YOUR PRODUCTS with NUGENT LUBRICATING SPECIALTIES

SIGHT FEED VALVES

Sight Feed Valves provide a means of regulating and visually checking oil flow at the point of delivery to bearings, gears, etc. By regulating the Sight Feed Valve, oil flow is controllable from 2 drops per minute up to 21 U.S. gallons per hour. The oil stream through the valve is visible at all times through a removable, dust-proof sight glass. Sizes ¼" to ¾" i.p.s. for working pressures to 125 p.s.i.



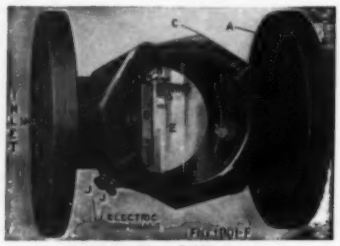
Sight Feed Valve

SIGHT FLOW INDICATORS

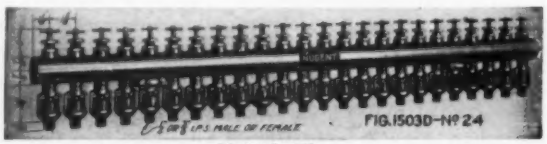
With a Nugent Sight Flow Indicator installed in your lubrication system, you can tell at a glance whether or not oil is flowing properly to vital parts. The Sight Flow Indicator can also be wired with an alarm bell to sound in any desired location—enables you to correct troubles quickly and protect valuable equipment. Windows are removable for cleaning. Sizes ½" to 6".

MULTIPLE OILERS

Nugent Multiple Oilers are designed for lubricating enclosed bearings and other hard-to-get-at spots. Oil from a pump or reservoir is piped to the oiler and fed to the bearings by means of tubing through independently adjustable needle valves. Available in a variety of types with any number of feeds.
In addition to lubrication specialties, Nugent offers a complete line of lubrication devices and oil filters. Write for descriptive literature, mentioning the type of equipment you are interested in.



Sight Flow Indicator



Multiple Oiler

Wm. W. Nugent & Co., Inc.
3412 Cleveland St. Skokie, Illinois

Established 1897

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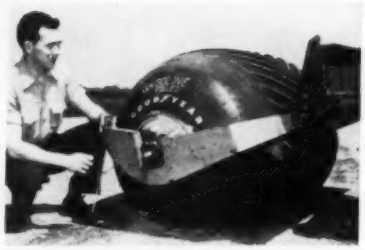


Fuel Storage

A watermelon-shaped rubber tank has been developed by the Aviation Products Div., Goodyear Tire & Rubber Co., Akron, O., that the firm says could revolutionize the bulk transportation and storage of fuels and other liquids.

Called the Rolli-Tanker, the container can be rolled over ground, floated in water and dropped without bursting. The company says it is expected to meet the needs of manufacturers, builders, farmers, the armed forces and others faced with liquid handling problems.

Rolli-Tankers are unconventionally-shaped tires of nylon cord and tread stock construction with fuel-proof inner lining. They can be built in a range of sizes. To date the company has tested 3½ × 5-ft tanks that weigh 40 lb deflated and give the appearance of oversized watermelons when loaded to 250-gal capacity.

Mounted on hubs and axles to permit easy handling, Rolli-Tankers may be towed manually or by vehicle. The containers have excellent flotation characteristics because of extremely low ground-bearing pressure. Only 30 lb of drawbar pull are needed to roll the storage units.

Filled Rolli-Tankers can be towed either singly or in tandem arrangements behind any vehicle equipped with a trailer hitch without affecting the vehicle's gross weight. Low footprint pressures permit them to be easily drawn over unprepared surfaces, such as rocky, uneven terrain, swampy soil and sandy areas. The pliable construction of the tankers conform to the shape of obstacles over which they pass.

Four-Way Valves

Mar Vista Engineering Co., 5420 W. 104th St., Los Angeles 45, Calif., announces the addition of Model 40 Series, four way valves, to its line of solenoid operated pneumatic and hydraulic valves.

As with its shut-off and three way versions, the four way valves are available for shipment within 24 hours, the company states.

Tube sizes from ¼ to ½ in. are available. The company says the valves feature low current drain, continuous duty operation, fast action, explosion proof, operating range 0–5000 psi, temperature range −65 to +275 F., and flow rates up to 10 gpm. Folders giving complete specifications are available from the company.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Transmitting Potentiometer

A new transmitting potentiometer which is based on an entirely new operating principle has been announced by the Industrial Controls Div., Manning, Maxwell & Moore, Inc., Stratford, Conn.

The company says the new unit permits measurement and control of low voltages while drawing negligible current from the source. It is available as a thermocouple pyrometer or to measure direct-current output of electrical transducers.

The new transmitting potentiometer uses no slidewires, batteries, standard cell, "chopper" or converter. It is said to have the simplest possible circuitry, with only two vacuum tubes. The input voltage is automatically balanced against the output signal by the use of the company's "Microsen" balance, which also maintains a constant reference voltage supply, accurate to 0.5 per cent without periodic standardization.

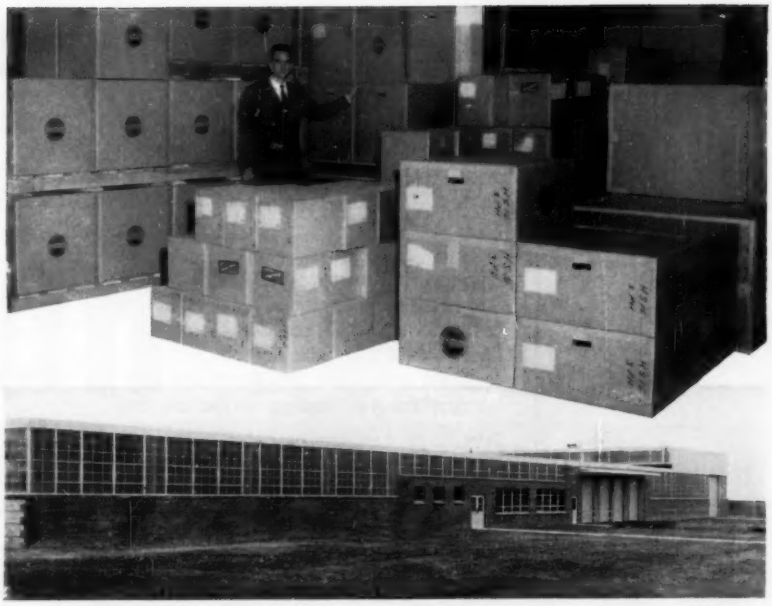
The transmitter is available in ranges from 6 to 50 mv (200 F and up), with zero suppression up to five times the span. An output of 0.5 to 5.0 ma direct current is produced, which can be transmitted over distances up to 30 miles. Repeatability is better than 10 μv, and accuracy is better than 1 per cent under supply voltage changes from 90 to 130 v. Speed of response for a 10 mv range is better than $^1/_4$ sec. for 90 per cent response, and speed increases directly with the range.

Pipe Thread Rolling

Two new universal pipe thread rolling attachments, Models PT-6 and PT-7, have been added to the line of thread rolling and oil grooving attachments manufactured by Salvo Tool and Engineering Co., 26441 Gratiot Ave., Roseville, Mich. The company says the new units are suitable for use on practically all types of hand and automatic screw machines, lathes, Bullards and other turning machines. They will roll several sizes of both NPT and NPTF threads.

The Model PT-6 for machines of $1^1/_4$-in. capacity and larger will roll five sizes of pipe threads: $^1/_8$, $^1/_4$, $^3/_8$, $^1/_2$ and $^3/_4$ in. The Model PT-7 for machines of $^9/_{16}$-in. capacity and larger will roll three sizes: $^1/_8$, $^1/_4$ and $^3/_8$ in. The new attachments, which operate on the machine during the machine cycle, eliminate the need for special threading machines or other secondary operations for threading, the company says.

Threads are held accurate to 0.0005 in. over very long runs without adjustment of the roll dies. Roll life up to 10 times normal expectancy is obtainable, the company says. A patented "lost motion" principle in the roll synchronizing drive gears releases the rolls after contact with the part. This, the company claims, eliminates sliding and galling on thread surfaces, greatly reduces breakage of gears and dies, and insures extreme accuracy and uniformity of threads over very long production runs. Time required for checking threads to maintain quality control is said to be greatly reduced.



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● Now! Doubled manufacturing and warehouse space permits Peerless to warehouse twice as many fans and blowers and increase our number of models from 250 to more than 400. When you need equipment for a complete air moving job, you can come to one source — Peerless — and get prompt delivery.

The big Peerless line is completely designed, engineered and manufactured under one roof. When you require special motors, our motor division produces them. We have complete control of all components going into every fan and blower. As a result, we can put our unqualified mechanical and performance guarantees on every unit leaving our plant.

Peerless builds to all industry standards — PFMA, NAFM and NEMA. If you require construction to meet other codes — either special industry or government — Peerless can do the job.

Engineering is the backbone of Peerless progress. Whether your installation problem is routine or complex, we'll work with you to solve it most efficiently.

Write today for Bulletins SDA-160 or SDA-200 for complete information on Peerless Forward and Backward Curve Blowers.

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Expansion within Northrop Aircraft's Structures Department is creating an urgent demand for qualified personnel in all phases of guided missile, piloted aircraft, and equipment development. Included among the most critical job openings are positions for:

Stress Department—Mechanical or Civil Engineers to design missile ground handling equipment. An opportunity for men without aircraft experience to take advantage of the aircraft pay scale.

Structures Research—Creative engineers for three vital phases of Structural Research and Development: Thermo-Structural Analysis, High Speed Computing Technique Development and Structural Materials Research.

Weight Engineering—Junior Weight Engineers for diversified phases of missile and aircraft projects. Excellent opportunities for advancement in a relatively small department.

Dynamics—Experienced flutter engineers required for work on a variety of dynamics problems including flutter models, analytical work involving electronic computers, and methods development.

Loads—Exciting and diversified assignments in the fields of both piloted and pilotless aircraft are now available in Structural Loads Group for engineers of all experience levels.

Stress Department—Experienced Structural Engineers for positions on Long Range Interceptor Project and on advanced missile designs.

A wide diversification of assignments within each field of specialization awaits the men capable of filling the above assignments. Responsibilities will include work on many phases of missile and aircraft design, guidance systems and boundary layer research.

If you qualify for any of these challenging opportunities, we invite you to contact Manager of Engineering Industrial Relations, Northrop Aircraft, Inc., Hawthorne, California, or call ORegon 8-9111, Extension 1893.

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PIONEERS IN ALL WEATHER AND PILOTLESS FLIGHT

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Heat Exchangers

A new line of standard heat exchangers in sizes from 20 to 400 sq ft of surface is being produced and stocked for immediate delivery by Struthers Wells Corp., Warren, Pa. Standardization of design and components permits sale at relatively low cost, according to the manufacturer.

Types of standard heat exchangers include fixed tube sheet, floating head, and U-tube units. Condensers, coolers, heaters and reboilers are supplied in single and multipass tube arrangements.

Construction of these standard heat exchangers may be of carbon steel, nonferrous alloy and stainless alloys Types 304 and 316. The equipment is said to meet highest construction standards, including ASME Code and TEMA Class A.

Phasemeter, Plotter

Hastings Instrument Co., Hampton, Va., has released its miniaturized and improved raydist equipment, including a new raydist dynamic phasemeter and a raydist plotter, small and light enough to be installed in the pilot's compartment of aircraft to give continuous flight position data.

The new phasemeter the heart of the precise raydist positoning system, is said to have many advantages over the previous unit. The firm says tests show that with good signals it has three times the accuracy of the previous unit, and even greater accuracy improvement with poor signals. The model should be superior under thunderstorm conditions, the company says. The new phasemeter unit reduces the number of tubes by eight for a complete two-dimensional unit. In the new phasemeter only 80w of electrical energy are required for its operation in comparison with 165w for a 2-dimensional old type unit. The new phasemeter is capable of following much more rapid changes in phase, and has much less lag than the previous unit.

The phasemeter unit weighs 8 lb, less than $1/2$ the weight of the previous unit; the space requirements are approximately 25 per cent of the former unit, and has approximately 10 times the torque on the shaft. It is capable of driving counters, potentiometers, digitalizers, and devices for which the previous units were not practical, except in the microtorque range, the firm states.

The new raydist plotter, a small automatic plotter designed primarily for aircraft applications, allows the pilot of a ship or aircraft to see continuously his position plotted directly on a chart. This is an advancement over the previously delivered automatic plotting boards used with raydist, which by their size and weight were necessarily confined to use aboard ships or at fixed ground locations, the company points out.

Continued on Page 50

Mr. Engineer:

A young, dynamic industry set to expand by 1100% by 1975 offers challenging, ground-floor advantages!

Can You

Chemstrand, already with the world's largest integrated nylon plant, is now in its 4th major expansion in its 4th year of operation!

Read Between

Being both a young and an expanding company, Chemstrand offers many positions that otherwise would require years to attain.

These Lines?

The booming, rapidly-expanding Southeast is America's new industrial frontier. Here the future has just begun!

WRITE TODAY if you think you can qualify for a position on Chemstrand's team.

TECHNICAL PERSONNEL MANAGER, Dept. ME-6
The Chemstrand Corporation, Decatur, Alabama

Gentlemen:
It is my understanding that you need for immediate employment graduate engineers in various fields, particularly chemical, mechanical, industrial, textile and instrument engineering.

I am a graduate_____engineer.
Please send me information concerning the ground floor opportunities at Chemstrand.

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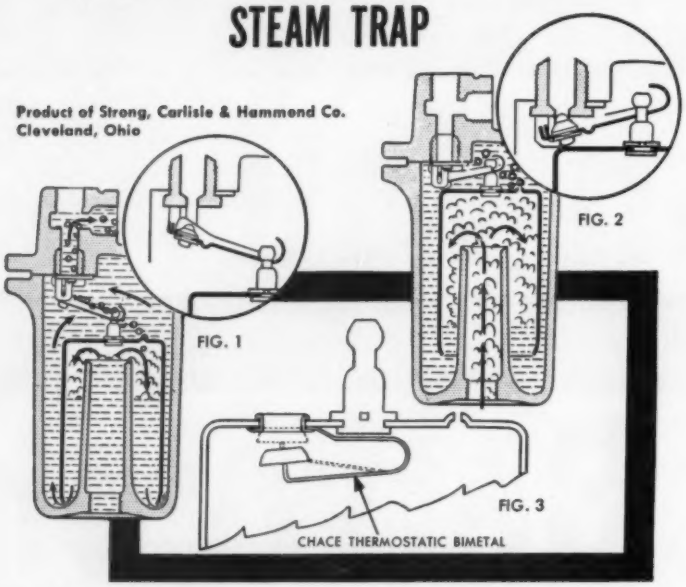
TOMORROW'S BIG DECISIONS WILL BE MADE **by the men who act today...**

HOW CHACE THERMOSTATIC BIMETAL ACTUATES THE STRONG HYDRO-FLEX STEAM TRAP

Product of Strong, Carlisle & Hammond Co.
Cleveland, Ohio



Strong Hydro-Flex Steam Traps combine high discharge capacity with highly efficient operation under all condensate loads to provide lower steam costs and higher production. The Hydro-Flex Traps operate with equal efficiency on both heavy and light loads.

How it works: (Fig. 1) When the steam trap bucket is down, water (condensate) flows unrestricted through the trap. (Fig. 2) When steam and air enter the bucket it becomes buoyant, moving the valve into the valve seat. Air and steam continually pass through the fixed vent in the bucket. The air collects around the valve and when the weight of the bucket overcomes the remaining buoyancy of the bucket it pulls the valve from the seat and the trap discharges the air ahead of the condensate by means of line pressure. When additional incoming steam enters the bucket again, the trap closes and the above cycle is repeated.

Where excessive air venting capacity is required, the Strong bucket is fitted with an auxiliary thermal venting valve. This is actuated by a Chace Thermostatic Bimetal element which responds to temperature changes by deflecting to open or close the air vent in the top of the bucket.

Chace Thermostatic Bimetal is available in 29 types in strip, coil or in complete elements made to customer specifications. Write now for our free 36-page booklet, "Successful Applications of Chace Thermostatic Bimetal."

W. M. CHACE CO.
Thermostatic Bimetal
1619 BEARD AVE., DETROIT 9, MICH.

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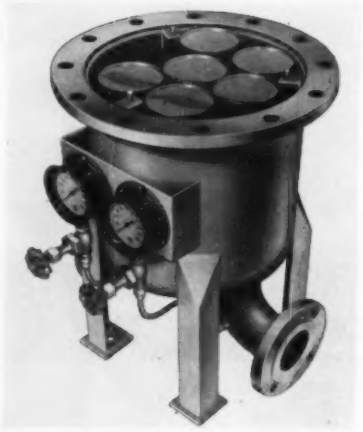

Polishing Filter

Pioneer Filter Div., Komline-Sanderson Engineering Corp., Peapack, N. J., announces a new line of micronic filters for the oil and chemical industries.

Available with either permanent or disposable type micronic filter elements for cleaning jet fuels, aviation and commercial gasolines, fuel and light lube oils and for polishing many chemical products, standard filters are manufactured in sizes from 50 to 1200 gpm glow capacity and meet all code requirements, such as API-ASME, ASME, state codes, JAN and MIL specifications. Custom designed filters are available in many metals and are manufactured to fulfill special installation requirements.

Complete package unit consists of filter, pressure gages, vent and drain connections, mounting legs and pads.

Elevator-Conveyor

"Smoothflo," a new type of continuous-flow elevator-conveyor, has been developed by The Fairfield Engineering Co., Marion, Ohio.

It is described as an improved continuous flow or en-masse type of elevator conveyor incorporating features that reduce the thrust of material against the side walls of the duct. This is accomplished by the design of the flights which carry a substantial percentage of the unit loads as in a bucket elevator. The chain is of malleable iron with hardened alloy-steel pin locked in the bar end and articulating in the forked end of the link to give a broad bearing surface.

The "Smoothflo" is suitable for flowable granular or pulverized materials not actively abrasive or corrosive, and for a capacity range of from 3 to 50 tons per hour. It operates at speeds of 30 to 60 fpm, occupies less space in cross section than a screw conveyor, about one-third as much as a belt conveyor and one-fifth as much as a bucket elevator. It is self-loading to capacity, requires no feeder and, if required, can automatically proportion two differing materials.

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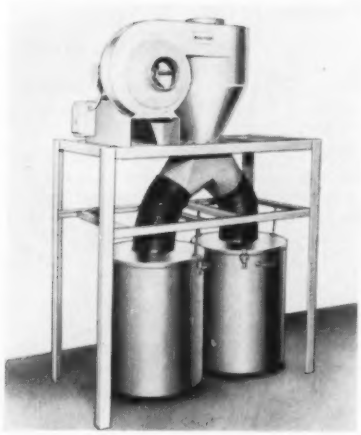
NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS



Dust Collector

A new model dust collector, to be used expressly where the outside expulsion of the cleaned air is necessary or demanded, has been announced by Aget Mfg. Co., Adrian, Mich.

It is known as the 11NW50 and is specifically designed for outside air exhaust, where application of recirculating air collectors is not practicable or is prohibited by local regulation. The unit is also adaptable to be used at installations where toxic fumes, obnoxious odors or smoke, as well as dust, accompany the operation for which the collector is used.

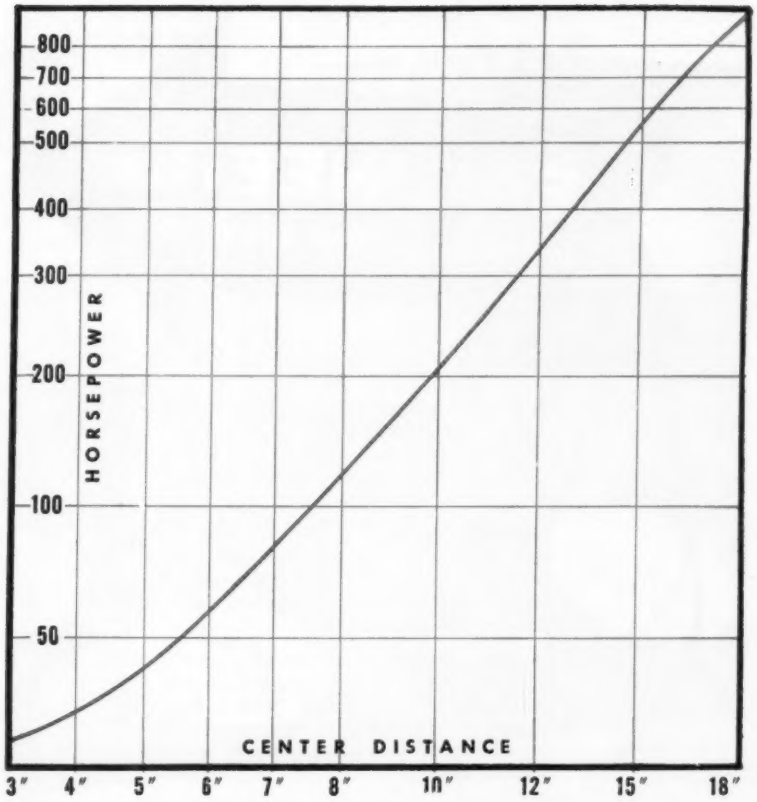
The collector does not remove the fume or odor from the air but merely exhausts it out of doors through a pipe which is connected to the outlet collar at the top of the Cyclone separator. The unit has an increased capacity up to 64 gal. and should be used where dust, shavings, chips, or other collected material runs to greater volumes, the company says. The collector is built with framework of welded angle iron and dust drums of heavily reinforced sheet metal. A wire reinforced neoprene flexible hose which connects to the rubber castered storage cans individually, and to the collector by a diverting "Y" to divert the flow of dust to one can while the other is removed for dumping.

Gage Case

A new gage case construction "Safecase," providing maximum safety on dangerous installations has been developed by Jas. P. Marsh Corp., 3501 W. Howard St., Skokie, Ill.

In the Marsh "Safecase" a solid front protects the gage face and a thin stainless plate, covering the entire back of the case relieves all explosive pressures. The back plate is held firmly to the case by two holding screws—eliminating all possibility of the back plate becoming detached in the event of a blow-out.

The new "Safecase" is claimed by the manufacturer to offer the maximum protection for all industrial gages installation.



WE LEFT COMPETITIVE RATINGS OUT OF THE CHART PURPOSELY..

. . . because we think the load-carrying capacity of Cone-Drive speed reducers is pretty impressive all by itself. Then, we've also got a lot of friends in the worm gear speed reducer business. And they make pretty fair reducers themselves.

Two things are responsible for the high capacity of Cone-Drive speed reducers. First, we use extra-heavy gears mounted on oversize taper roller bearings in reinforced, heavy housings. Extra "beef' alone accounts for part of our capacity.

Even more important, however, is the Cone-Drive double-enveloping worm gear design. Here, we literally wrap worm and gear around each other to put ⅛ of all teeth in continuous full-depth contact. This results in spreading tooth contact ovet a greater area, reducing pressure on individual teeth, increasing load capacity and life of the gearing.

Ask for Bulletin 600C without obligation.

CONE-DRIVE GEARS
Division, Michigan Tool Company
DOUBLE ENVELOPING GEAR SETS & SPEED REDUCERS
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Mechanical Engineers for experimental testing and development, mechanical design, stress and vibration analysis, combustion research, heat transfer, nuclear reactor development.

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Engineering Physicists to assist in nuclear reactor design and development, including the analysis and development of controls, systems and instrumentation.

If you are looking toward "tomorrow"

. . . you could choose no better road than the one leading to the development of a reactor-powered aircraft engine at Pratt & Whitney Aircraft. Ours is a progressive organization, quick to encourage, recognize and reward professional achievement. To further assist you in reaching your ultimate goal, there is also the newly established Rensselaer Polytechnic Institute graduate center where advanced degrees may be obtained.

If you have at least a B.S. degree, this may be your opportunity to get into a promising new field.

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Thermostat Metal

A thermostat metal, said to be ideal for use in the heating and ventilating industries, is now in production at the plant of the American Silver Co., 36-07 Prince St., Flushing 54, N. Y.

The company says the new material is finding application in such devices as stacks, furnace controls, dampers, radiator valves, steam traps, and room thermostats. It is known as thermostat bimetal ASC-1.

The metal has a deflection range of −100 to 700 F, with maximum sensitivity from 0 to 300 F. In addition, it has a high deflection rate, high torque, and good strength properties up to 800 F. Electrical resistivity is high and corrosion resistance good, the firm states.

ASC-1 is produced in thicknesses down to 0.001 in., widths down to 0.093 in. in coils or lengths cut to order. The company fabricates spiral and helical coils, flat blades, U-shapes, cantilever strips and other elements.

Solenoid Selector Valve

A new line of constant gain solenoid selector valves for aircraft oil-hydraulic systems featuring a "packaged" design of seven-units-in one is now available from Vickers Inc., 1400 Oakman Blvd., Detroit 32, Mich.

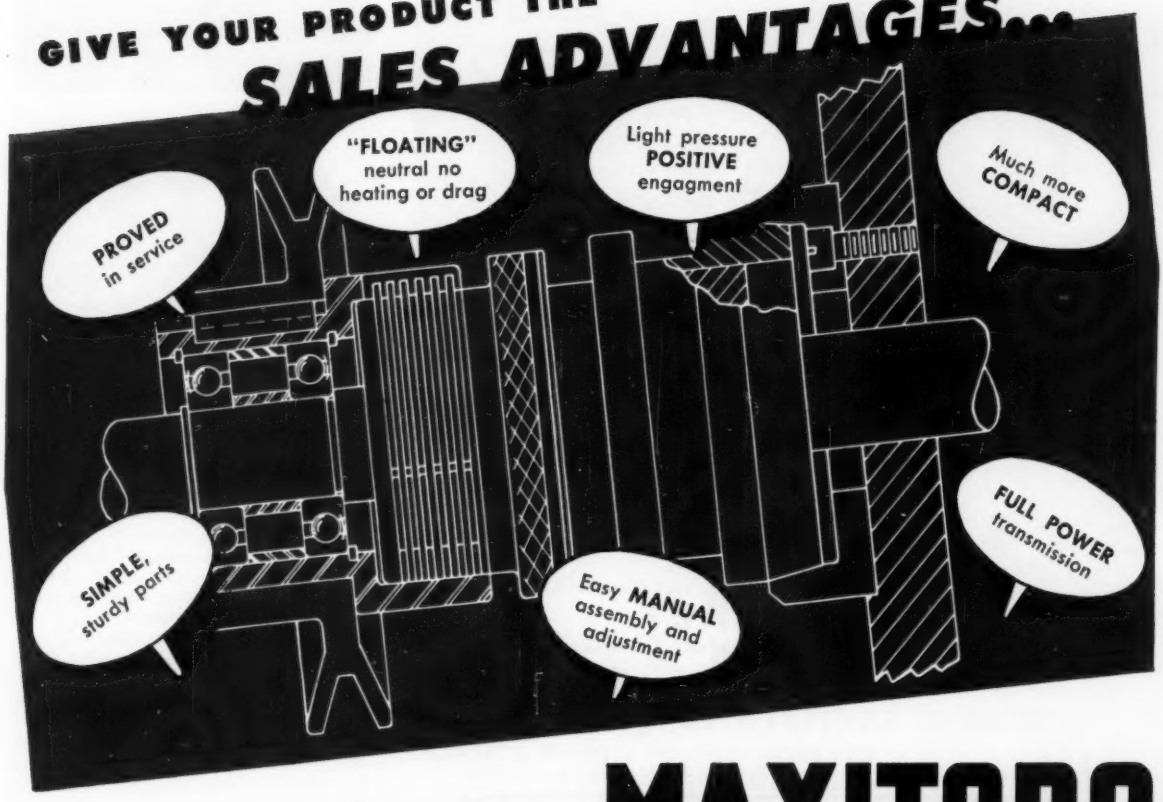
The new units are basically four-way, closed center solenoid selector valves with special modifications said to suit them ideally for any oil-hydraulic system utilizing an on-off (contactor) type servo-mechanism control. They are designed specifically for high pressure, high temperature installations requiring two-way actuation of controls at two different rates of response, such as the control of a turbo-jet variable exhaust nozzle. Operation of the new valve is governed by 28v d-c electrical input signals provided by the engine speed control or any other system requiring electrical input.

The new solenoid selector valve is a packaged unit containing within a single housing a restrictor and by-pass valve arrangement, a pressure relief valve, two thermal relief valves, a pressure switch, an electrical solenoid-operated shut-off valve, and a check valve. The company says this packaged design feature results in minimum weight and envelope with a great reduction in the amount of external plumbing required.

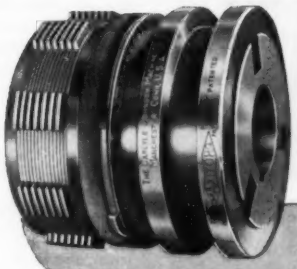
The valves are recommended by the company for use with system operating pressures up to 4500 psi, ambient air temperatures up to 350 F, system-fluid temperatures up to 300 F, and return-fluid temperatures up to 400 F. They are built around the company's exclusive "hydrostat" metering principle that provides inherent low pressure-drop characteristics while controlling overrunning loads without cavitation or excessive pressure build-up. Being a constant gain type, the new valve maintains constant flow regardless of load magnitude.

Continued on Page 54

GIVE YOUR PRODUCT THE SALES ADVANTAGES...

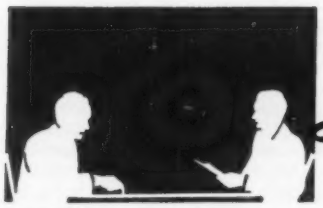


...OF A PROVEN MAXITORQ floating disc CLUTCH



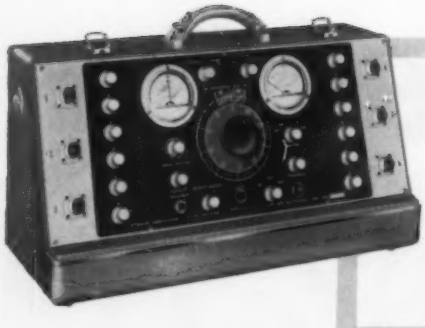
The above line drawing illustrates a single MAXITORQ Clutch arranged for single V-belt drive with a special sliding beveled shifter sleeve acting as a light brake.

Yes, there are many types of MAXITORQ . . . single, double, overload release . . . to meet every installation need. Get our comprehensive technical data . . . let our engineering department help you work out special drive problems. Write or phone: Dept. ME-3, The Carlyle Johnson Machine Company, Manchester, Conn.



Let's talk MAXITORQ

SCJ59



RS-20

Indicates strain directly

Accurate to ± 2 micro-inches-per-inch

Battery or a-c operation

Available in 2, 6, or 12 channels

Measure Strain Easily

Make strain measurements simply . . . rapidly . . . accurately . . . with a Hathaway RS-20 Strain Indicator. Save hours of tedious calculation by using this new and versatile instrument.

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More and more these days you hear top engineers talk about the many growth opportunities at Melpar. With an increasing number of significant electronic projects, an enlarged staff and facilities, Melpar provides many opportunities for professional growth and advancement. Our new laboratory is an engineer's dream come true; a building conceived by and constructed for the ENGINEER – 265,000 sq. ft. of complete engineering facilities.

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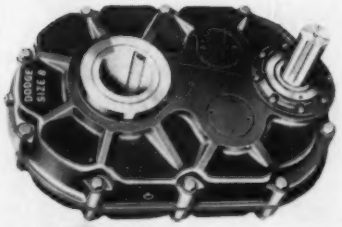

Speed Reducers

With the recent addition of two models to its Torque-Arm line, Dodge Mfg. Corp., Mishawaka, Ind., now offers shaft-mounted speed reducers, with capacities from 1 to 60 hp and output speeds from 12 to 365 rpm.

The new size No. 8, in the double reduction series, extends the advantages of shaft mounting, plus the performance and economy features of the firm's Torque-Arm speed reducers, to big jobs, the company says. The unit has a capacity of 60 hp at 100 rpm, AGMA rating, and can be mounted on shafts up to 5 in. diam. At the other end of the line is the new No. 11, with a capacity of 1.3 hp at 100 rpm.

The firm states that no foundation, no flexible couplings, no sliding base is required for any of these reducers, and there are no lining up difficulties. The reducers are mounted directly on the shaft, and the torque-arm is fastened to any fixed object, anchoring the reducer. The unit is driven through a V-belt drive. Sheaves permit any speed ratio desired.

The Tri-Matic overload release which loosens the belts, cuts off power and gives a warning in case of excessive load is available for use with the reducers. A built-in backstop may also be provided when conditions require a device to prevent the reversal of the direction of rotation.

Rotary Switches

Rotary switches for operating such electrical instruments as ammeters, voltmeters, frequency meters, and P. F. meters; for such control functions as synchronizing, temperature indicating and on-off operations, and for controlling such electrical equipment as circuit breakers, transformer tap changers, motor operated rheostats, and governor motors are described in an eight-page bulletin released by Allis-Chalmers Mfg. Co., 949 S. 70th St., Milwaukee, Wis.

Operation of the switches is discussed and actual installations on vertical and bench-type control boards are illustrated. Flexibility is achieved by mounting each pair of stationary contacts on individually molded bakelite-base blocks. This unit construction makes it possible to add stages to existing switches and to replace contacts. All contacts are made accessible by removable snap-on cover which can be lifted from either top or end. Arrangement of the terminals permits wiring without removing this cover.

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NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Radiant Heating Units

Two new types of radiant heating equipment have been introduced by Fostoria Pressed Steel Corp., of Fostoria, Ohio. The company says the ovens and their components use infrared sources considerably different from the well-known and widely used infrared lamps.

The components include quartz lamp oven sections, and radiant rod oven sections, both designed for easy assembly into complete infrared ovens. The new quartz lamp equipment was developed by the firm to accommodate a new source of radiant energy particularly suited to high temperature applications, making possible product temperatures in excess of 1000 F.

The new lamp, designated T-3, has a high temperature (4000 F) tungsten filament, like the G-30 infrared lamp; but the filament is sealed in an inert gas atmosphere, within a translucent, fused quartz shell. This design permits high radiation efficiency. Linear in shape, with metal sealed ends, the T-3 lamp has a rated, trouble-free burning life in excess of 5000 hr, the company states. The new lamps are moisture-proof, highly resistant to impact and vibration and are practically impervious to thermal shock. The company says the equipment is ideal for drying, curing, degreasing, baking, and preheating, and is especially recommended for high temperature, short cycle applications where instantaneous response is required.

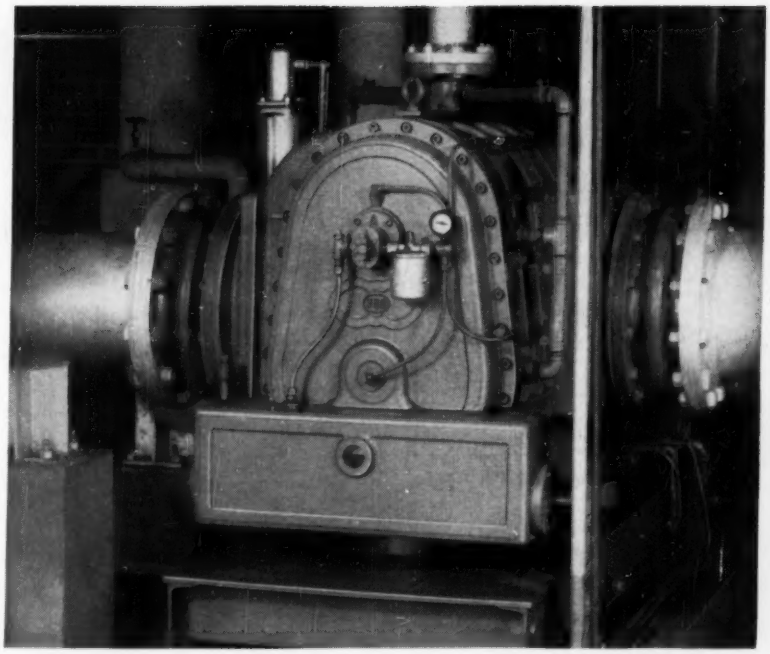
The new radiant rod equipment, incorporating sheathed metal elements, can be quickly interlocked to form oven walls of high intensity. The firm says this equipment is particularly suitable for rugged-duty applications, and in many cases, one-fourth to one-third fewer units are needed for a given operation.

Injection Molding Machine

A 24-oz horizontal plastics injection molding machine has been introduced by Watson-Stillman Press Div., Farrel-Birmingham Co., Inc., Roselle, N. J.

The new model is designed to give faster cycles and high plasticizing rates. It incorporates a straight hydraulic mold clamp with an adjustable clamping stroke. The new heating cylinder design features an internally heated torpedo with four zone heat control for better plasticizing at lower temperatures. The injection plunger is prepositioned so that the mold is filled immediately after dies are clamped. Both the pressure and speed of the injection stroke is adjustable in stepless variation. A stuffing arrangement increases the maximum shot capacity by approximately 40 per cent.

The firm says an improved base design affords greater accessibility to pumping unit and piping. The pumping system consists of a radial piston type pump connected to a 60 hp 1200 rpm motor. The pump features an unloading control that is said to reduce the pump stroke and function to maintain the preset pressure continuously



4 years of gruelling operation frequently at overload pressures and still no maintenance needed

Since 1951, Standardaire Blowers installed at Spencer Chemical Company have been operating 24 hours a day supplying process air for production of synthetic ammonia.

Although normally operated at 1750 rpm and 8 psig, these units periodically are required to run at more than 50 percent above rated capacity for as long as a month at a time. When brick and catalyst dust seal over reformer catalyst beds, this pressure is needed to force the gases through and avoid costly shutdowns.

After four years of this gruelling, continuous operation, a recent test disclosed virtually no reduction in efficiency of the Standardaire Blowers. They have required no maintenance.

Exclusive cycloidal design and simple, compact construction enable Standardaire Blowers to move more gas or air per pound of blower, with less wear, less maintenance and power consumption. Write for complete information.

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U.S. DISASTER MAP

You help others—you help yourself— when you join your Red Cross

There are 317 crosses on this map. Each marks a Red Cross Chapter where disaster struck suddenly in 1953-1954 and where the Red Cross working with local organizations gave relief to disaster sufferers.
What will the Disaster Map for 1955 look like? Will there be fewer crosses? Or more? No one knows. But one thing is certain: Year in and year out, on the average, your Red Cross working with other local agencies gives relief in 6 disaster calls a week somewhere in the U.S.A.

When It Happens No One Is Alone...

You will be there—because your Red Cross will be there!

That is the Red Cross way when disaster strikes; when blood or first aid save a life; when a serviceman or his family needs a helping hand.
If you believe that no one should be alone in time of trouble—that no one should be alone in giving help—you will join your Red Cross and support it generously.

ANSWER THE CALL! JOIN YOUR RED CROSS!

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with automatic follow-up without excessive heating or power loss. A new prefill system designed with a shock piston for decompression relieves shock at the prefill valve.

The unit is designed for the future installation of a Watson-Stillman preplasticizing unit which will increase the capacity to 90 oz. A floor mounted electrical control panel furnished with the 24-oz machine has provisions for the installation of the preplasticizer.

The machine is supplied with a standard self-compensating type hopper and feeder. A weigh feed mechanism can be provided as additional equipment. The machine can also be furnished with ram spacers which reduce the minimum die thickness requirements and low pressure closing for additional mold protection.

Draftsman's Aid

Drafting procedure is said to have been facilitated with the development of Draftray, that places working tools at the draftsman's fingertips, yet off the drawing board.

A partitioned tray, swivelly supported by a ball and socket joint on a fully adjustable arm which clamps to the edge of the drawing board, provides unobstructed use of board, drafting machine, straight edge or T-square.

The unit provides orderly space for all the tools a draftsman requires and permits instant adjustment to correspond with all angles of the drawing board.

It is manufactured and sold by the Draftray Co., 1316 E. 24th St., Minneapolis 4, Minn.

D-C Motors, Generators

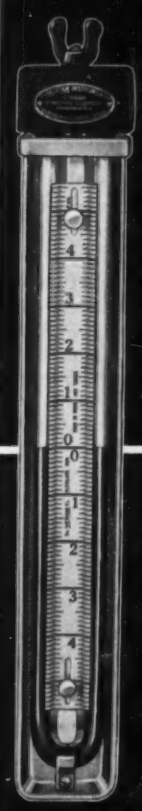
A new line, designated Kinamatic, said to be the first complete line of industrial d-c motors and generators built to the latest NEMA standards for future design is announced by the direct current motor and and generator department of the General Electric Co., Schenectady 5, N. Y. All motor ratings from 1 to 150 hp and all generator ratings from 3/4 to 100 kw are available.

The motors have been designed for exceptional versatility and may be used in either constant or adjustable speed applications, the company said; speed may be adjusted by either armature voltage control, field strength control, or any combination

UNMATCHED ACCURACY

with simplicity / and economy

AT LOWEST COST . . . this Meriam Manometer offers high accuracy. The Meriam B-1103 is the easy-to-use, always dependable form of pressure or flow instrumentation. Pressures to small fractions of an ounce are read directly, accurately . . . without calibration or instrument adjustment . . . with complete enduring manometer reliability.



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of both. New higher base speeds are available. For constant horsepower applications, higher top speeds can be obtained through field strength adjustment.

The d-c motor can also be applied where extra power at high speeds is needed. Through "forcing"—the application of overvoltage—many ratings can operate at proportionately higher speeds and horsepower, the company points out. When properly applied, the Kinamatic motor can operate at any speed below base speed, including stalled torque.

Faster speed of response is made possible by a significant reduction in armature inertia and electrical time constant permitting, the company says, split-second response for quick stops and starts and fast reversals and speed changes.

Peak commutation, designed to take safely the short bursts of power necessary for quick acceleration and deceleration, has been built into the new motor. Fewer turns per armature coil are said to assure minimum inductive kick when stored energy is released from the coil, and a full complement of commutating poles is designed to permit greater overloads without magnetic saturation.

Full Class B insulation, a high volume fan and improved air flow enable General Electric to guarantee a 15 per cent service factor in all standard dripproof motors.

Brushes are accessible through large hand holes. The brush spring may be disengaged with one hand, then hangs captive to the brush holder but clear of the brush for replacement. Brass brush holders and molded polyester glass yokes are used. Ball bearings are packed with a special G-E lubricant. Grease fittings permit relubrication without disassembly of the motor. Split, cast iron, waterproof conduit boxes, available in three sizes for each motor frame, provide room for wiring connections. The standard motor has a rolled steel frame with cast iron dripproof endshields. An eyebolt is provided on all motors.

Ultraviolet Microscope

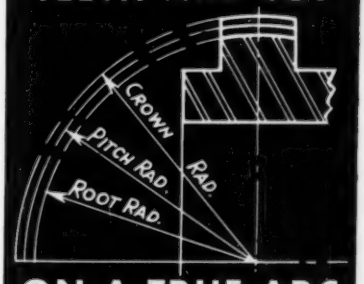
Norden-Ketay's automatic color translating ultraviolet microscope is available for accurate structure determination and indication of absorption spectrum.

The ultraviolet microscope is the newest means for studying not only the geometry, but also the chemical similarities and dissimilarities of objects within specimens of various types. It is useful in investigations in biology, medicine, physics, metallurgy, and many other fields.

Four-page illustrated Bulletin 370 describing applications and operating principals is available. This bulletin contains a bibliography of experimental results obtained with the microscope. Copies of this bulletin and additional information may be obtained from Boston Electronics Div., Norden-Ketay Corp., Snow & Union Streets, Boston, Mass.

Here's the Big DIFFERENCE

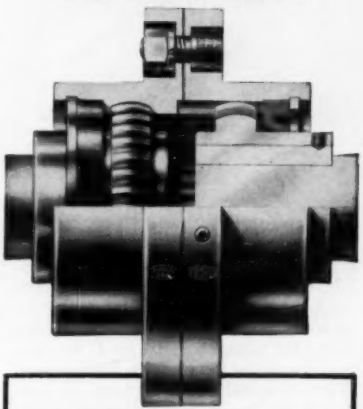
TEETH ARE CUT



ON A TRUE ARC

SPHEREFLEX®

COUPLING



SPHEREFLEX tooth design features an exclusive curved root and spherical tooth flank. Both angular and linear (parallel) misalignment are compensated for, since every portion of each gear tooth is actually a segment of a sphere. This special design eliminates all possibility of tooth interference and permits increased deflection between mating members. Full and uniform line contact, through the working depth of the tooth, insures a stronger coupling between driver and driven shafts; eliminates point rolling contact between gears during flexing; compensates for shaft misalignment up to 14° included angle. Send for Catalog C-560

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NEW YORK • PITTSBURGH • CHICAGO • HOUSTON • LYNCHBURG, VA.
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Virginia Gear & Machine Corp., Lynchburg, Va.
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Established 1892

HOLTZER -CABOT

R-24 Motor

Synchronous and Induction Capacitor Type Motors

R-25 Motor

R-24. Typical applications for this reversible, 4-pole induction motor are in servo mechanisms, as a balancing motor in recording instruments or as a control motor for voltage regulators. It has low rotor inertia for fast response applications. When operated 2 phase, it can be controlled electronically; or operated single phase as a permanent split capacitor motor.

R-25. Typical uses are for recording instruments, dictating and adding machines. Approximately 2½" in diameter, it is available in either induction or synchronous construction with reversible rotation.

Both the R-24 and R-25 are available with gear case speeds from 1/2 to 3600 RPM, torque ratings up to 75 oz. inches or higher, and single phase, 2 or 3 phase.

HOLTZER-CABOT ESTABLISHED HC NP

HOLTZER-CABOT MOTOR DIVISION
NATIONAL PNEUMATIC CO., INC.
125 Amory Street, Boston 19, Mass.

GENTLEMEN: Please send me data sheets on the Holtzer-Cabot R-24 and R-25 Size Motors.

Please have representative call _____ (date)

Name _____

Company _____

Street _____

City _____ Zone ____ State _____

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Aluminum Alloy

A new aluminum casting alloy which is relatively unaffected by nickel shortages was announced today by Aluminum Co., of America, 1501 Alcoa Bldg., Pittsburgh 19, Pa.

Designated as F132, the new alloy was developed primarily to replace the firm's older automotive piston alloy, D132, which has a higher nickel content. Since an emergency would quickly curtail the use of nickel, F132 offers a more dependable material, the company points out.

Properties of the new alloy are virtually identical to D132, according to the firm. Extensive test runs in a representative group of automotive engines proved F132 pistons would operate equally well.

The nickel content of D132 alloy has a range from 0.5 to 1.5 per cent. Alloy F132 has a 0.5 per cent nickel maximum.

Pressure Gage

A compact, precision high temperature pressure gage, said to be capable of giving continuous and accurate readings of pressure under prolonged exposure to high temperatures and radiation has been developed by Callery Chemical Co., 201 N. Braddock Ave., Pittsburgh 8, Pa.

The gage, Model C, is available in standard and special pressure ranges. It operates on a c from 60 to 400 cycles in continuous radiation flux of one million Roentgens per hour.

The gage may be installed on any pipe or vessel for use with high temperature liquids or gases. According to the company, its application is not limited to any specific liquids or gases as the pressure-sensing bellows may be manufactured from a wide variety of resistant materials with its scope of usefulness increasing accordingly. The instrument consists of the bellows, a differential transformer and a meter to indicate variations in the transformer output. The bellows and transformer constitute one compact unit connected by cable to the receiver which may include either a direct-reading or a recording meter.

The gage operates by measuring the change in electrical output in the secondary of the differential transformer caused by movement of the core. The core is connected by a direct linkage to the bellows. Any change in pressure on the bellows causes a directly proportional movement of the core, which, in turn, induces a variation in the electrical output of the transformer. The gage is not temperature sensitive.

Since many applications of this type of gage are in systems where any leakage is detrimental, the bellows, located immediately below the transformer, serves as a secondary seal. When the instrument is used in systems containing material with a relatively high melting point, an additional safeguard against leakage is provided by solidification of the material in the housing of the linkage.

VOLUME makes the GEARS GO 'ROUND

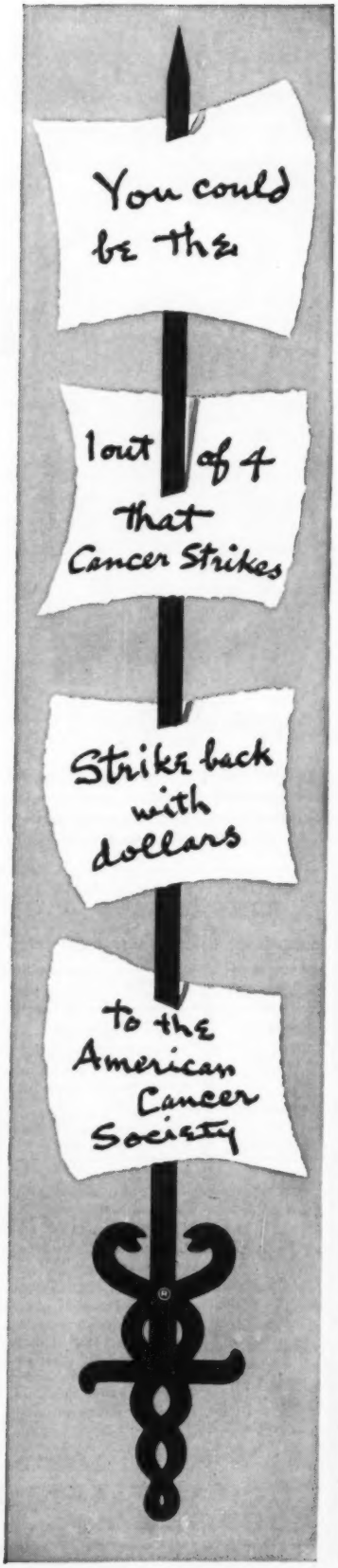
P. W. Melter

MASTER MECHANIC, THE CINCINNATI GEAR CO.

Do you know what a small spiral bevel gear generator costs at today's prices? Approximately $35,000! And the cost of the work done by this machine represents on the average only about 15% of the total cost of producing a spiral bevel gear. Thus you can see it requires *volume* production and *maximum* utilization to make such expensive, specialized equipment pay off. And yet without such equipment, whether it be this spiral bevel gear generator or any one of the other pieces of capital equipment in our plant, it would be impossible to produce quality custom gears at a competitive price.

The sales and production departments have a big responsibility to keep these machines busy and earning their keep, but their efforts would be wasted if we didn't have the *right* tools in the first place. It is my job to see to it that we *have* these tools — that our plant is equipped with the most modern and efficient equipment available — through continuing re-evaluation of our present installations and constant searching for new and improved machines. When I can find equipment which would be superior to present equipment, I take the facts to top management. I've found in my 43 years' experience that in a progressive firm like ours these recommendations are usually acted on favorably — and promptly. That's how we manage to maintain a completely modern gear manufacturing plant, and thus produce progressively better gears more efficiently for you, our customer.

THE CINCINNATI GEAR CO.
CINCINNATI 27, OHIO
"Gears — Good Gears Only"



KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Hydraulic Pumps

Hydreco Div., New York Air Brake Co., 1100 E. 222 St., Cleveland 17, Ohio, has developed a new series of 150 hp, 1500 psi hydraulic pumps for heavy mobile and industrial equipment. Pumps in the new 3600 series are especially engineered for installations where space is extremely limited and where adverse conditions exist.

The new pumps will deliver 65-90-110 gpm at 1200 rpm, depending on the model. Speeds range to 2000 rpm; pressures to 1500 psi and fluid horsepower to 150 hp. Companion control valves have also been designed for the new high-volume series.

Counterpoise Relay

Cook Electric Co., Diaphlex Div., Chicago, Ill., announces several new models of their counterpoise relay, including a tandem-type, 24-pole, double-throw model, a 12-pole design, a relay for 400 cycle input and also several special application designs, all employing the counterpoise principle. This counterpoise principle is said to offer a new relay concept in precision with dependable performance, immunity to vibration and shock, small size and light weight such as required in aircraft and missile components.

Device Eliminates Pallets

Hyster Co., 2902 N. E. Clackamas St., Portland 8, Ore., has introduced its new "Cart-N-Grab" to handle cartons and packages without pallets on 3000 and 4000 lb capacity lift trucks.

The unit's arms—said to be the widest in their field—will accommodate packages from $22\frac{1}{8}$ to $70\frac{3}{4}$ in. Incorporating both the firm's "load-grab" and side shift features, the new device holds entire packages firmly to eliminate spillage or damage.

Arms are said to operate faster than any comparative models and the side-shift feature permits faster positioning.

Balanced Screen Conveyor

IMCO balanced screen conveyors by Williams and Green, Clearfield, Pa., are being released for general distribution for the first time.

Designed for operation without the use of rigid mounting installations, the conveyors provide low cost screening or coarse sizing from $\frac{1}{8}$ in. up on coal, stone, ores, sand, gravel, the company states. The units are built to operate from any existing power supply, and are available in standard sections for conversion into screens, conveyors, picking tables, sizing, or scalping screens. Sections and model are furnished in the combination of screening surfaces and lengths best suited for a particular job.

The units are constructed of heavy duty, structural steel plate and with wire mesh, perforated plate, flange lip, or any other required screen dressing.

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for complete data on

WILLIAMS-HAGER FLANGED *Silent* CHECK VALVES

Williams-Hager check valves provide economy with silent operation in all types of piping systems installed in public buildings, utilities, waterworks, industrial plants, oil refineries, paper mills, chemical plants, hospitals and other buildings. Send coupon for complete details contained in Bulletin 654.

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THE WILLIAMS GAUGE CO., INC.
149 Stanwix St., 2 Gateway Center
Pittsburgh 22, Pa.

Please send me a copy of Bulletin 654 on Williams-Hager Flanged Silent Check Valves.

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CHECK VALVES
THE WILLIAMS GAUGE CO., INC.
2 Gateway Center Pittsburgh 22, Pa.

OUR 70TH ANNIVERSARY 1886—1956

IT'S EASY

TO SELECT A PRESSURE OR TEMPERATURE CONTROL FOR ANY APPLICATION WHEN IT'S A

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THE MERCOID CORPORATION
4201 Belmont Ave., Chicago 41, Ill.

KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

Running Torque Tester

Type 200 running torque testers and dynamometers designed to measure the operating characteristics of fractional and subfractional horsepower motors were recently introduced by John Chatillon & Sons, 85 Cliff St., New York 38, N. Y.

The dynamometers are supplied in two basic models, the smallest model No. 210 DY will test 1/10 hp motors up to a speed of 10,000 rpm, while the larger model, No. 220 DY, will test up to 1/4 hp motors to the same speed.

Model 210 DY has a maximum torque capacity of 1 in. lb with an accuracy of 1/2 per cent, while model 220 DY has a maximum capacity of 5 in. lb with the same accuracy. Both models are supplied with interchangeable torque cells to reduce the capacities and thus achieve greater accuracy of torque reading.

These units utilize hysteresis brakes. Another feature is overload protection to prevent the damage to the brakes and the brake cells. Incorporated also are the firm's Iso-Elastic springs said to provide the units with temperature protection over a wide range of ambient conditions. Torque control is entirely independent of speed variation, and torque is maintained at 0 rpm.

Laminating Press

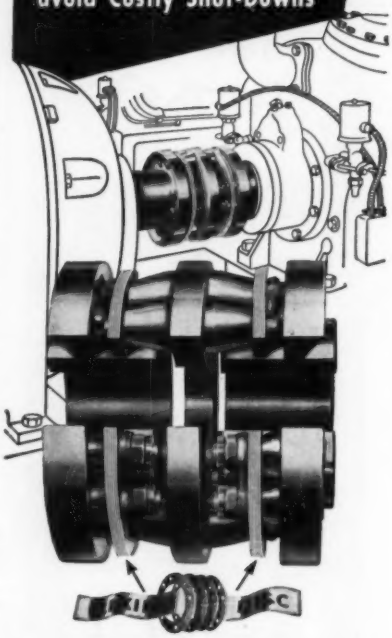
The Wring-Master rotary press, a new rotary laminating press suited for contact bond adhesives and assembly line production of laminated panels has been introduced by Rodney Hunt Machine Co., Orange, Mass. The pressure system of the new machine insures excellent bonds because of vertical alignment of the pressure rolls regardless of panel thickness.

The new Wring-Master unit is provided with a positive nip adjustment for precise setting of pressure roll gap (or daylight opening) for panel thickness up to 5 in. With this gap established, the machine can be left in operation; panels are automatically pulled through the press at speeds ranging from 15′ to 30′ per minute as they are inserted in the nip. A $2^1/_2$ in. diam Neoprene covered stabilizing roll mounted immediately behind the nip prevents fluttering of rigid panels passing through.

Rolls are furnished with a special heat-resistant Neoprene covering of specified density which will withstand attack of solvents used in clean-up operations as well as the effect of residual heat of panels coming from the infra-red re-activating oven.

The Wring-Master unit can be loaded up to 8000 lb with 8 in. diam direct acting pneumatic cylinders. On a 48 in. wide panel, this results in a lineal load of 175 lb-in. (or 150 psi, as the nip width is approximately $1^3/_{16}$ in.), which is more than adequate for bonding the majority of panels. To obtain this same unit loading for panels up to 60 in. wide, the loading may be increased to 10,000 lb by the substitution of 9 in. diam cylinders.

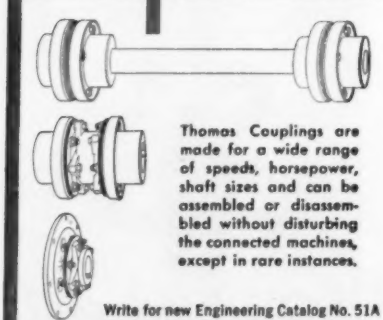
Specify THOMAS ALL METAL FLEXIBLE COUPLINGS for Power Transmission to avoid Costly Shut-Downs



Patented Flexible Disc Rings of special steel transmit the power and provide for parallel and angular misalignment as well as free end float.

DISTINCTIVE ADVANTAGES

FACTS	EXPLANATION
NO MAINTENANCE	Requires No Attention. Visual Inspection While Operating.
NO LUBRICATION	No Wearing Parts. Freedom from Shut-downs.
NO BACKLASH	No Loose Parts. All Parts Solidly Bolted.
CAN NOT "CREATE" THRUST	Free End Float under Load and Misalignment. No Rubbing Action to cause Axial Movement.
PERMANENT TORSIONAL CHARACTERISTICS	Drives Like a Solid Coupling. Elastic Constant Does Not Change. Original Balance is Maintained.



Thomas Couplings are made for a wide range of speeds, horsepower, shaft sizes and can be assembled or disassembled without disturbing the connected machines, except in rare instances.

Write for new Engineering Catalog No. 51A

THOMAS FLEXIBLE COUPLING CO.
WARREN, PENNSYLVANIA, U.S.A.

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NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

O-Ring Flange Unions

W-S Fittings Div., H. K. Porter Co., Inc., P. O. Box 95, Roselle, N. J., now offers a line of 2-bolt and 4-bolt flange unions with O-ring seals.

The unions are used in hydraulic equipment lines, process piping, water lines, refrigeration piping and many other applications. The O-ring provides a tight seal against fluid pressure. Flanges are made of high strength forged steel with high tensile studs.

The unions are available in 3000 lb class in both screw-end and socket-welding types. The 2-bolt unions are available in sizes $\frac{1}{4}$ to $1\frac{1}{4}$ in.; 4-bolt unions in sizes 1 to 2 in. O-rings are available in a variety of precision molded materials to resist a wide range of service conditions.

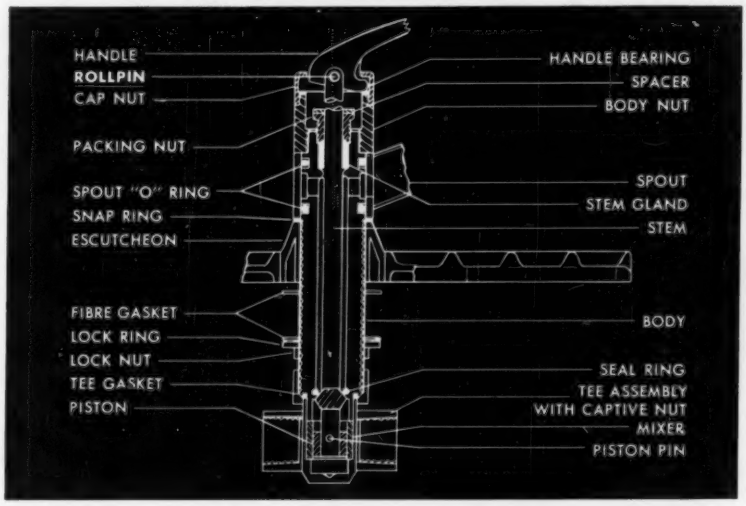
Thyratron Speed Control

Now available from Ther Electric Wks., Dept, MXN, 17 S. Jefferson St., Chicago 6, Ill., is a new variable speed motor drive consisting of a d-c motor with an electronic rectifier power supply. The company says this thyratron control permits constant full load torque at all speeds from minimum to maximum and has a speed range of 10 to 1. The unit is called the Theratrol.

The electronic rectifier power supply is a grid controlled regulated variable armature supply and a fixed field supply. Six Xenon-filled thyratron tubes accomplish the armature rectification and no other tubes or thermionic devices are used. The maximum armature current is limited by a control circuit which can be adjusted from 100 to 200 per cent of full load. The firm states the current cannot exceed this pre-set value even though the motor is stalled with the speed control in the maximum speed position. The pulse firing of the thyratron tubes eliminates electrical interference and assures stable control settings.

A compact box houses the speed control. Simple lever operation determines the armature voltage to the motor and consequently its speed. The rectifier is regulated at any particular setting. Speed regulation with load, therefore, is almost as good as the

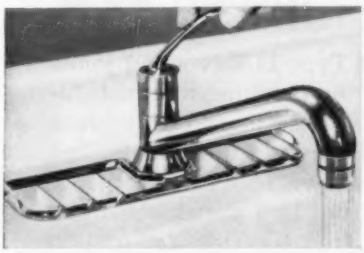
FASTENER PROBLEM



Reducing fastener costs of new design faucet

Faucets with a single handle to control both water temperature and volume of flow have been known in the plumbing trade for years. But premium prices necessitated by high production costs held back their acceptance. Gyro Brass Manufacturing Corporation is now producing a single-handle faucet at a competitive price because a better fastening method helps to keep assembly costs in line.

Rollpin, the pressed fit spring pin with chamfered ends, is used in place of a screw to fasten the handle to the stem. This eliminates the need for milled flats on the stem. A hole drilled to normal tolerances is all that is needed. The number of operations has been reduced, production time is cut and a 77% cost savings is realized. This change to a simple, efficient fastener was of primary importance in achieving the desired price reduction.



If you use taper pins, set screws, rivets, hinge pins or any other pin type fastener, consider redesigning with Rollpin for a cheaper, faster assembly.

MAIL COUPON FOR DESIGN INFORMATION — ROLLPIN TRADEMARK

Elastic Stop Nut Corporation of America
Dept. R42-311, 2330 Vauxhall Road, Union, New Jersey

Please send me the following fastener information:

☐ Rollpin bulletin
☐ Elastic Stop® nut bulletin
☐ Here is a drawing of our product. What fastener would you suggest?

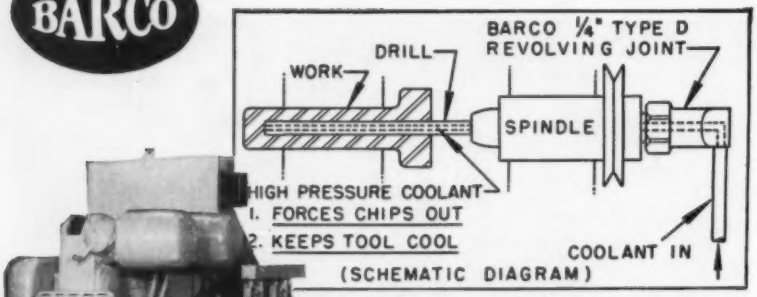
Name_____ Title_____

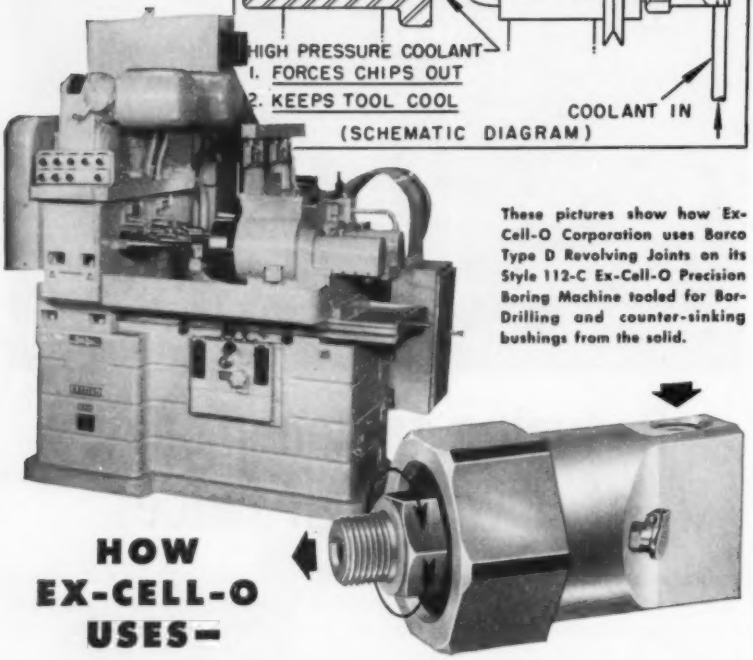
Firm_____

Street_____

City_____ Zone_____ State_____

BARCO





These pictures show how Ex-Cell-O Corporation uses Barco Type D Revolving Joints on its Style 112-C Ex-Cell-O Precision Boring Machine tooled for Bor-Drilling and counter-sinking bushings from the solid.

HOW EX-CELL-O USES—

New High Speed Barco Revolving Joints

for speeds up to 10,000 RPM

BARCO'S new, high speed Type D Revolving Joints are especially designed for machine tool installations. Ex-Cell-O Corporation uses them to introduce coolant under high pressure through the spindles and Bor-Drills of the machine shown above to force out chips and keep the drills cool (see sketch). Barco's Type D Joints are well-suited for this application because of their precision construction and compact design. Exclusive seals are self-adjusting for wear and permit operating speeds as high as 10,000 RPM on coolant service. Joints can be used on pressures to 300 psi (air) or 1500 psi (hydraulic). Temperatures from −20° to +225°F. For complete information, write BARCO MANUFACTURING CO., 521D Hough Street, Barrington, Illinois.

BARCO

THE ONLY TRULY COMPLETE LINE OF FLEXIBLE BALL, SWIVEL, SWING, AND REVOLVING JOINTS

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

motor alone, dropping only about 150 rpm on a 1750 rpm motor, the company says.

The position of the two-way speed control lever determines the direction of rotation. Reversing is accomplished by a double pole mechanically and electrically interlocked reversing contactor in the armature circuit. Contacts are carbon to copper. The circuit is opened and closed electronically in the tube circuit.

This Reversing switch has a dynamic brake with a special relay to prevent reverse rotation until the motor is at a standstill. Smooth acceleration to maximum speed in the other direction then builds up at the preset maximum armature current.

The unit is designed for three-wire remote control. The thyratron tubes are preheated for two minutes by synchronous electric motor timer before the control handle can operate the motor. When the rectifier is energized, the full field connects to the motor. A standby relay in the rectifier prevents operation in case of field failure. The units are available in 10 to 50 hp sizes, 450 to 3600 rpm. Speeds above normal are also available and other sizes and speed ranges are under development.

Crane Remote Control

Femco, Inc., Irwin, Pa. has developed a new electronic system to provide remote control of traveling cranes from the plant floor.

Carrier current over existing power rails is the only circuit required. Installation is simple for any crane or similar device now in use or in new construction, the company says. No additional power rails are required.

With the new control, an operator can raise or lower the hoist (5 positions), position the trolley forward or reverse (5 positions), travel forward or reverse (3 positions) and can energize or turn off the magnet, all from the floor. As many as eight cranes can be controlled on one power circuit by use of different carrier frequencies and one operator can operate more than one crane. By use of two control panels, a crane can be loaded by one man and then sent to the other end of its runway where another man can unload it and send it back.

In operation, high-speed synchronous relays on crane and floor panel operate whenever levers are moved. Carrier frequency on each step is shifted down to a lower frequency for an "off" control and up to a higher frequency for an "on" control. Whatever control is sent during one operating cycle is stored by a "sealing-in" relay until changed by another operating cycle. The small relays which operate in a few milliseconds are repeated by contactor type relays for the actual control. An emergency stop switch is provided to cut off the carrier and open the control contactors if the relay system or carrier link should fail at any time.

The floor control panel may be in a permanent location or may be placed on a cart for portability from one to another power receptacle.

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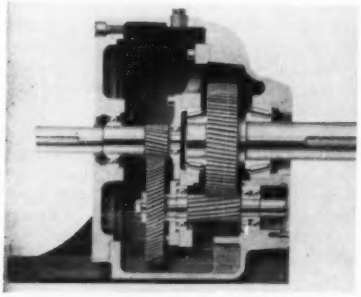
NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS



Helical Gear Drives

Link-Belt Co., has developed a new line of in-line helical gear drives, said to combine a high degree of standardization with ability to stand up in heavy duty service.

Double reduction drives are available in ratios from 6.2 to 1 through 38.4 to 1, with capacities up to 118 hp. Triple reduction drives are available in ratios from 47.1 to 1 through 292 to 1, with capacities up to 20 hp.

The firm says these drives offer many refinements in design and manufacturing methods which result in high precision, compactness and quiet operation. One-piece cast iron housings, with reliable oil seals at shaft openings, prevent oil leakage. It has cast iron construction.

The design of all drives permits the addition of an integral positive-locking backstop at any time without modifications, the company says.

Information about the drives is found in a new Link-Belt 16-page book, 2651. It contains cutaway views of both the double and triple reduction drives, together with instructions for proper selection, load classes for over 250 applications, overhung load ratings and dimension tables. Book 2651 can be obtained from Link-Belt Co., Dept. PR, 307 N. Michigan Ave., Chicago 1, Ill.

Electronic Recorders

A new line of recording millivoltmeters and microammeters has been announced by the Industrial Controls Div., Manning, Maxwell & Moore, Inc., Stratford, Conn.

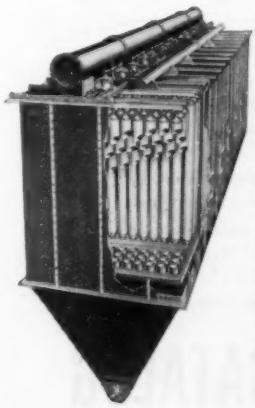
With a measuring element that is said to be more than 50,000 times more powerful than conventional direct-deflection movements, the pen drive mechanism has ample power to operate alarm contacts with no loss of accuracy, the firm states.

This new "American-Microsen" Series 130 electronic recorder is designed in the "graphic" style, recording on a 3-in. wide chart while using panel space of less than 25 sq in. Both continuous strip charts and IBM type card charts are available. Recording is on straight-line coordinates.

The recorder measures input signals with electro-mechanical transducer and amplifier which drives a rotary solenoid to position the pen. A feedback spring from the pen arm to the input transducer force balances

That's the guarantee you get with **Norblo** Automatic Bag Type Arresters

By "constant" we mean what operating men *expect* it to mean when applied to dust collection — *no* loss of suction drop, *no* down time, *no* variation in capacity.



Norblo's unit compartment system, with automatically controlled progressive and cyclic bag cleaning maintains the full capacity for which the particular installation is engineered. Bag cleaning is easily regulated if dust loading rate should change. Only one compartment is cut out at a time for cleaning (and that for only a few seconds) by means of moderate shaking which insures long bag life. A small quantity of reverse air is used to prevent unwanted dust flow during shaking operation. Excess dust is dropped without destroying the desirable basic filter cake.

Profitable, consistent performance of Norblo automatic dust and fume collection equipment is demonstrated in hundreds of important installations. If you need this facility for production, for salvage, or for good housekeeping, ask Norblo engineers what they can do for you. Write for Bulletin 164-4.

The Northern Blower Company

Engineered Dust Collection Systems for All Industries

6421 Barberton Ave. OLympic 1-1300 Cleveland 2, Ohio

Nagle®
PUMPS
HANDLE SLURRY
AGAINST 400' HEAD IN
MODERN POWER PLANT

Two Nagle 4" type "T" pumps, in a two stage installation, are ably handling 600 GPM of fly ash slurry against 400 ft. of head, at Windsor plant of Beech Bottom Power Co., Power, W. Va. Water-end parts are of abrasion resistant ABK Ni-Hard nickel iron alloy.

Design of the Nagle type "T" pump provides quick slippage seal adjustment, accessibility of stuffing box and split bearing stand. Entire pump can be quickly dismantled, but it's seldom necessary because it's a Nagle Pump—built for gritty, abusive jobs—pumping abrasive and corrosive materials or hot liquids.

SEND FOR CATALOG 5206

NAGLE PUMPS, INC.
1299 CENTER AVE., CHICAGO HEIGHTS, ILL.

NAGLE PUMPS

PUMPS FOR ABRASIVE AND CORROSIVE APPLICATIONS

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WORKING FOR YOUR COMPANY?

As an ASME member, you received a Request Card to be filled in and returned if you wish to receive a copy of the 1956 Mechanical Catalog. Distribution is limited . . . return your card promptly. In addition to its comprehensive directory of over 40,000 listings it contains thousands of detailed product descriptions provided by hundreds of leading manufacturers. Now in its 45th year, Mechanical Catalog is the super market for mechanical engineers. It gives you product facts fast, up-to-date, accurate. If you did not receive your MC Request Card, use your letterhead to reserve a copy.

MECHANICAL CATALOG

Published annually as a service to members by

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

29 West 39th Street, New York 18, N. Y.

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the pen position in precise relationship with the input signal. The company says the resulting power eliminates the usual limitations of low-level electrical measurements, such as pivot friction errors, vibration effects, and excessive maintenance.

The recorder is available, as a microammeter, in ranges from 0–200 microamperes to 0–100 ma. As an mv, it is available in ranges from 0–20 mv to 0–100 v with input sensitivity to 6700 ohms per volt. Accuracy is within 0.5 per cent of the range. Repeatability is better than 0.25 per cent of range. The recorder responds to input changes of less than 0.2 per cent of range.

Speed of response is 0.5 seconds for 63 per cent of a step change. On special order, response speeds up to 0.2 sec for 63 per cent can be furnished. A switch is incorporated in the recorder to increase this response time by a factor of four in order to damp out unwanted fluctuations.

Temperature Controller

Black, Sivalls & Bryson, Inc., 7500 E. Twelfth St., Kansas City 26, Mo., introduces a new Type 1460 temperature controller for positive fluid flow control through diaphragm operated valves, based on temperature variations.

Equipped with an external vapor-tension thermal system to actuate the power unit in the pilot, the unit offers a choice of temperature ranges. By simple adjustment, it permits either 100 per cent throttling action or on-off snap action within a wide limiting range.

The unit has all the features offered in the 1440 and 1450 pilots built by the company, being identical except for the actuating mechanism. Two pressure gages and a temperature indicator are compactly built into the pilot case.

A-C Motor Lines

Two new lines of enclosed, nonventilated, fan-cooled motors have been announced by General Electric's Small Integral Motor Dept., Fort Wayne, Ind.

The new a-c lines are designated as "Standard Enclosed" and "Severe Duty Enclosed." They will replace a single line of 1–5 hp motors.

The standard enclosed motor features a steel conduit box and fan cover. The conduit box has keyhole mounting. A ½-in. conduit hole with a 3/4 in. knockout is provided. The conduit box is completely gasketed with cork neoprene. The fan cover is of steel and cast iron is retained on the rest of the enclosure.

Both new lines feature longer permanumbered leads. Every enclosed, foot-mounted motor is now equipped with a lifting eye.

Severe duty line is basically the same as the standard line, except for certain features which make the severe duty motor suitable for use in corrosive or excessively moist atmospheres, the company says.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTE
LATEST CATALOG

Metal Bonding

A new structural metal bonding adhesive called Resiweld is announced by the H. B. Fuller Co., 181 W. Kellogg Blvd., St. Paul, Minn. The adhesives will permanently bond aluminum, steel, zinc, copper, brass, iron, glass, wood, rubber, and plastic surfaces to themselves and to each other, the firm says. The bonds formed combine high structural strength with excellent impact resistance.

Resiweld has remarkable resistance to solvents, grease, water and chemicals and the ability to withstand severe conditions of treatment and exposure. The adhesive is said to be particularly suitable for manufacturing, assembling, laminating and repairing where high strength, permanent, structural bonds are required.

Technical information and direction pamphlets outlining the properties of this new adhesive are available from the company.

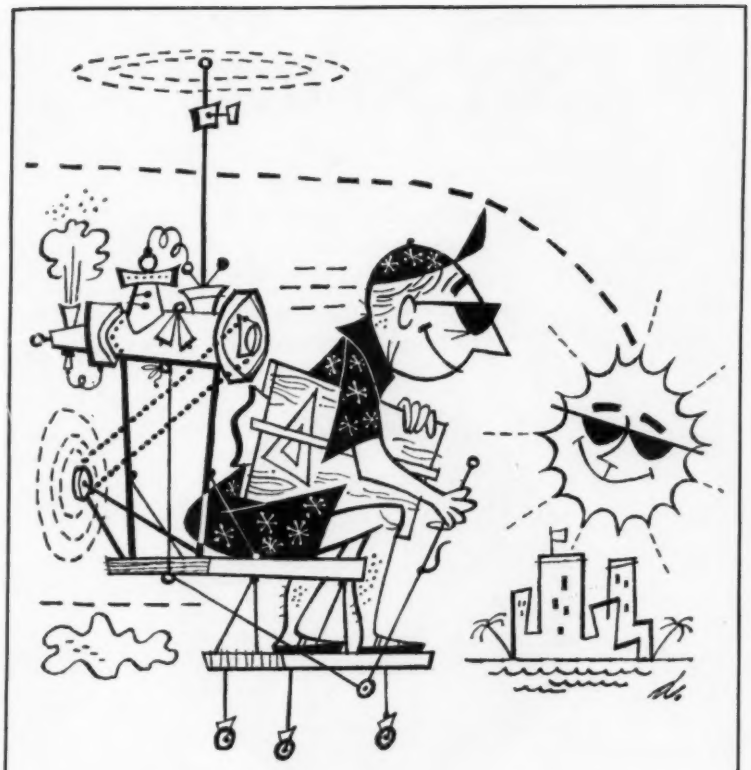
Selector Valves

A line of 3-way selector valves for 3000 psi service, now available from Aircraft Products Co., 300 Church Rd., Bridgeport, Pa., is said to handle 85 per cent higher flows than conventional models.

Available in two size ranges—Series 6000 for $1/4$ and $3/8$-in. tubing and Series 6050 for $3/8$ and $1/2$-in. tubing—these lightweight solenoid-operated units permit flow in any direction and feature a compact porting configuration.

The Series 6000 valve will handle up to 6 gal of fluid per min through either $1/4$ or $3/8$-in. tubing, in comparison with maximum flows of 3.2 gpm for standard $3/8$-in. valves. Essentially, this valve is a $3/8$-in. unit, but can also be furnished with $1/4$-in. ports. The Series 6050 is basically a $1/2$-in. valve, but can be furnished with $3/8$-in. ports for use where low pressure drops are required, or where higher rates of flow are encountered.

The firm says the flow can be reversed between any two open ports without disturbing the flow or operating characteristics of the valves. This is accomplished by a fully bal-



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SANDIA CORPORATION, a subsidiary of the Western Electric Company located in Albuquerque, N. M., is engaged in the design and development of nuclear weapons under contract with the Atomic Energy Commission. Compensation is competitive with that offered in other industry, and employee benefits include exceptionally liberal paid vacations, free group life insurance, sickness benefits, and a generous contributory retirement plan. Interview and liberal relocation expenses are paid by Sandia Corporation. Albuquerque, center of a metropolitan area of 186,000, is located in the Rio Grande Valley, one mile above sea level. Urban shopping facilities, scenic beauty, historic interest, year-round sports, and sunny, mild, dry climate make Albuquerque an ideal home. Housing is readily obtainable.

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SANDIA CORPORATION, Albuquerque, N. M.

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SANDIA CORPORATION

ALBUQUERQUE, NEW MEXICO

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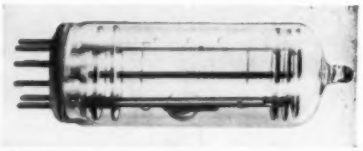
anced inverse poppet which permits a wide range of flows and pressures in any direction. Because of the inverse poppet, perfect alignment with seat axis is guaranteed.

The valves, rigidly qualified to surpass MIL-V-5529A in every respect, are characterized by compactness and light weight. Port sizes meet AND-10050 -4, -6, -8 specifications. The weight of the 6000 Series is 1.50 lb and that of the 6050 Series is 1.61 lb.

The ambient temperature range of these valves is from −65 F to 160 F. Valves with wider ranges can be had on special order. Both the 6000 and the 6050 are provided with single coil solenoids operating in the range of 18–30 dc in accordance with MIL-S-4040A.



Miniature Crystal

A 1000 cycle miniaturized crystal unit has been developed by the James Knights Co., Sandwich, Ill., for applications in the low frequency range requiring both extreme stability and miniaturization. The new unit, the JK-G7J, is specially processed and sealed in a glass-enclosed vacuum.

It is said to have a higher merit factor due to its vacuum enclosure, and a secular stability of less than 0.002 per cent per year. It has a temperature stability of ±.012 per cent over a temperature range of −40 to +70. Or, when oven controlled in the firm's Thermystal design, it provides temperature stability of ±.0001 per cent over an ambient range of −55 to +55.

This new miniature crystal unit is also available in a MIL type HC13U holder.

Subminiature Clutch

Precision Specialties' subminiature clutch features a positive-displacement drive that transmits up to 15 in.-oz of torque at speeds to 1800 rpm without external lubrication and at higher speeds in an oil bath. The clutch is an all-purpose model that can be used for any single-revolution, over-running, nonreversing, or indexing application within its capacity. The unit has an extremely low moment of inertia, 93.0×10^{-7} in.-oz-sec^2, making it ideal for any application requiring fast response under high loading. Maximum drag torque is 0.5 in.-oz.

The clutch is $1^1/_4$ in. long with a maximum diameter of $^5/_{16}$ in. It is available from stock with either a coupling-end or through-shaft mounting. Miniature models with torque capacity of 10 in.-lb are also available.

For additional information, write R. S. Baer, Sales Manager, Precision Specialties, 1342 E. 58th St., Kansas City 10, Mo.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Brinell Hardness Tester

A new low-cost motorized Brinell hardness tester, announced by Steel City Testing Machines, Inc., 8817 Lyndon Ave., Detroit 38, Mich., is said to combine operating economy with simple operation and dependable accuracy. Designed for both laboratory and shop use, the Model "L" is priced to compete with and replace hand pumped machines.

The new bench model is a motor-operated hydraulic machine with finger-tip load application, long stroke to eliminate anvil height adjustments and positive accuracy of loads well within ASTM standards. The Brinell load, adjustable by turning a screw, is provided by a motorized hydraulic pump, with the oil reservoir contained within the machine frame. The operator applies the load by depressing a lever on the side of the machine, holding it down for the desired time interval. Releasing the lever instantly releases the load.

One of the features of the new model is the $^3/_4$-in. stroke of the Brinell ball penetrator. When testing a series of pieces of about the same thickness, it is not necessary for the operator to readjust the height of the anvil for each test.

Pneumatic Transmitter

A pneumatic transmitter that can accurately measure either temperature or gage, as well as absolute pressure over narrow and wide spans, has been introduced by Minneapolis-Honeywell Regulator Co., Industrial Div., Minneapolis, Minn.

The new instrument converts process temperatures from −375 to 1000 F, or pressures of from 40 to 600 psi to a standard 3–15 psi output. The company says simple adjustments make it possible to measure temperatures or pressures and to vary the span width or shift it anywhere within the range of the instrument. It is designed for use where close process control and versatility are required, in the food, chemical, and petroleum industries.

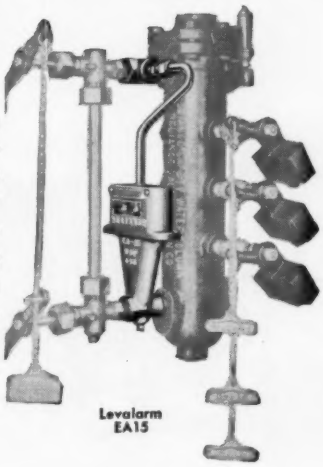
An addition to the firm's line of Tel-O-Set recorders, indicators, and controllers, the new unit is shock mounted and designed to resist the effects of vibration. It compensates for ambient temperature and barometric pressure changes, eliminating the need for adjustment as these conditions change. The instrument operates on the force-balance principle which virtually eliminates motion (on a full-scale deflection the primary element moves a few millionths of an inch) reducing wear and increasing longevity. A small, highly sensitive stainless steel bulb is said to provide fast response to temperature changes.

The firm says installation costs for the new transmitter are reduced because it uses inexpensive, low pressure tubing instead of the long-run capillary required by conventional instruments. Pipe, wall, or horizontal-well mounting is provided by a universal mounting bracket.

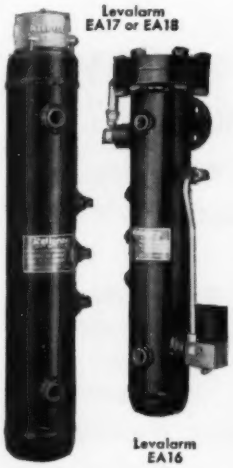
Tiny currents guard boiler safety

You can operate alarms, fuel cut-out, start and stop pumps safely and accurately with

Reliance Levalarms®


Levalarm EA15

Now you can protect any boiler, from lowest pressures to 2500 psi, with a completely electrical fast-acting alarm system and other controls. Actuated by a tiny current — 25 milliamperes or less — relays pick up signals through the opening or closing of isolated electrode circuits installed on or in the boiler water column. Levalarms are unaffected by pressure, temperature or water conditions.

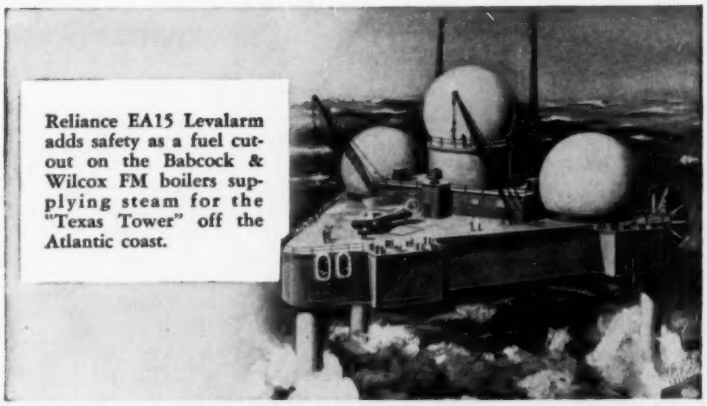

Levalarm EA17 or EA18

Levalarm EA16

Low alarm or high alarm or both, fuel cut-out, and starting and stopping of pumps thus are affected with the speed of electricity *within a small fraction of an inch* change of the boiler water level at predetermined safety points.

The simplest of four Levalarm models, shown above, is a fuel cut-out on a water column. Other variations are for higher pressures and wider variation of control combinations. For the full story about these new Levalarms, write for Bulletin D2.

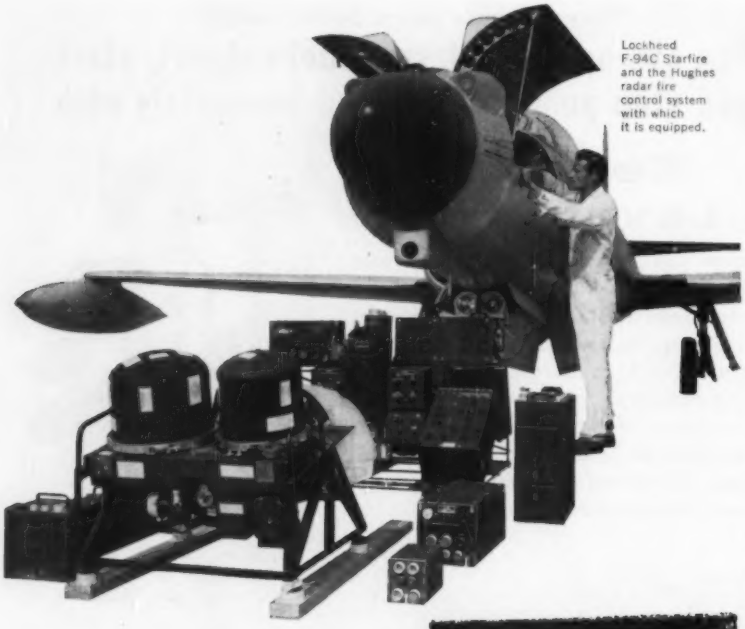
The Reliance Gauge Column Company
5902 Carnegie Ave. Cleveland 3, Ohio


Reliance EA15 Levalarm adds safety as a fuel cut-out on the Babcock & Wilcox FM boilers supplying steam for the "Texas Tower" off the Atlantic coast.

The name that introduced safety water columns....in 1884

Reliance®

BOILER SAFETY DEVICES



Lockheed F-94C Starfire and the Hughes radar fire control system with which it is equipped.

Hughes has been the leader from the beginning in applying electronic computers to airborne fire control equipment. Today every U.S. Air Force and Canadian continental defense interceptor uses Hughes-developed and Hughes-manufactured systems.

PRODUCT DESIGN at HUGHES

As the intercept problem becomes more and more automatic, additional equipment such as new-type computers, control surface tie-in (CSTI), autopilots, and other units must be integrated into the system. Faster speed and heavier engines dictate more streamlining—and hence less space for electronic gear. The result is even more miniaturization and compact packaging, evolved from special techniques.

This all means that now the product design engineer is more important than ever before. In the Product Design Laboratory he is a vital part of the formal link between the Research and Development activity and the optimum configuration and installation arrangements for the systems "black boxes."

Write to HUGHES *for information regarding positions open.*

SCIENTIFIC STAFF RELATIONS

HUGHES RESEARCH AND DEVELOPMENT LABORATORIES

CULVER CITY, LOS ANGELES COUNTY, CALIFORNIA

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Deviation Test Bridge

A new addition to the line of deviation test bridges, extremely fast direct-reading impedance comparison instruments, has been introduced by the Brush Electronics Co., 3405 Perkins Ave., Cleveland 14, Ohio.

The instruments are used primarily for production inspection, inspection of resistance, capacitance and inductance. They are designed to present accurately and quickly a comparison against a standard impedance indicating both percentage impedance deviation and phase angle deviation in radians on a 6-in. illuminated scale.

Wherever repetitive bridge type measurements are required, these bridges cut measuring time to a minimum, the company says. Interchangeable calibrated scales are provided for the ranges -1.5 to $+1.5$ per cent, -7 to $+8$ per cent, -25 to $+35$ per cent impedance deviation and -0.015 to $+0.015$, -0.07 to $+0.07$, -0.25 to $+0.25$ phase angle deviation in radians.

The new deviation test bridge model BL-1506 has a 100 kc bridge frequency for the test ranges 10 to 50,000 ohms resistance, 25 mmfd to 0.1 mfd capacitance, and 20 microhenrys to 80 millihenrys inductance. The other instrument Model BL-1504 has a 1 kc test signal.

For automatic inspection the meter can accommodate 4000 units per hour. The knee operated test jig accessory BL-3901 will greatly facilitate manual inspection procedures.

Needle Valve

A new 416 stainless steel needle valve designed for corrosive service and suitable for pressures up to 10,000 psi has been developed by the Jas. P. Marsh Corp., 3501 W. Howard St., Skokie, Ill. Constructed throughout of 416 stainless steel, these valves are claimed by the manufacturers to be the answer to dependable, safe, and accurate control of many corrosive fluids over a wide range of service requirements.

Valve bodies and valve stem guides are machined from solid 416 stainless steel bar stock. The valve stem is hardened 416 stainless steel precision machined with fine pitch threads for exceptionally fine regulation.

Deep chambered threads are machined to extra long length permitting even undersized pipe threads to make up tightly.

The packing used is of special durable quality called "Marpak," tailor-made to fit the extra deep packing space provided on all Marsh needle valves. This packing is exceptionally clean and easy to remove and install.

Double Acting Cylinder

A new double acting cylinder developed by Alkon Products Corp., 206 Central Ave., Hawthorne, N. J. has no metal-to-metal contact between its piston and the cylinder wall. The company says this feature prolongs cylinder life, and is achieved through the use of a

KEEP INFORMED | NEW EQUIPMENT BUSINESS NOTES LATEST CATALOGS

tough nylon bearing wrapped around the outer diameter of the piston. The self-adjusting piston packings of Block-Vee design yield negligible "break-out" friction.

A cushion arrangement, with cadmium-plated spring, spherical radius seal, and chamfered seat, is said to assure positive cushioning with immediate acceleration on the return stroke. In addition to standard 1-in. stroke, adjustable cushions for controlled strokes over 1 in. and up to 6 in. are available.

Three-way flush rabbet mountings—front, rear, and horizontal—are standard on all Model "D" double-acting cylinders.

The cylinder components include a seamless steel cylinder barrel which is roller burnished to a fine micro-inch finish and hard chrome plated. The cylinder head is machined from high tensile heat treated extruded aluminum bar, and the piston rod is hardened, ground and polished stainless.

Capable of operating under 250 psi (air) or 500 psi (water and oil), Model "D" cylinders exceed JIC standards, the firm says.

BUSINESS NOTES

Acquires Company

Morse Chain Co., a Borg-Warner subsidiary, has acquired Eberhart-Denver Co. of Denver, Colo., and its affiliate, the Spreco Co. of Chicago. Eberhart-Denver Co. is one of the country's leading manufacturers of speed reducers.

Eberhart-Denver presently manufactures a line of worm gear speed reducers, double reduction worm speed reducers, single reduction helical gear speed reducers, screw conveyor drives and gear motors.

Florida Representative

Morris Machine Wks., Baldwinsville, N. Y., maker of heavy duty slurry pumps, announces the appointment of J. E. Kennard, Tampa, Fla., as its sales representative in Florida except for the phosphate industry in the central part of the state.

New Development Center

The Lummus Company, designing engineers and constructors for the petroleum and chemical industries, located at 385 Madison Ave., New York 17, N. Y., is establishing an Engineering Development Center in Newark, N. J.

For this purpose, Lummus has purchased a 150,000 sq ft building on a 10½ acre plot near the Newark Airport.

Lummus, which has had similar facilities in Bayonne, N. J. for the past 25 years, will use the new building primarily for pilot plant operation and process development work carried out in conjunction with its clients.

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Raybestos-Manhattan combines top-flight design engineering with superior molding techniques. The result is an outstanding packing—in this case America's most copied packing. Whatever your hydraulic application, you can count on getting perfect performance from this self-sealing, self-adjusting packing—even at pressures in excess of 6000 psi. A fine seal results even when the equipment is motionless.

R/M MAKES A COMPLETE LINE OF MECHANICAL PACKINGS

R/M's line of molded hydraulic and pneumatic packings includes:

VEE-FLEX PACKINGS
VEE-SQUARE PACKINGS
HOMOGENEOUS VEE-RINGS
FABRIC PISTON CUPS

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RAYBESTOS-MANHATTAN, INC.
PACKING DIVISION, PASSAIC, N.J.
MECHANICAL PACKINGS AND GASKET MATERIALS

FACTORIES: Bridgeport, Conn.; Manheim, Pa.; No. Charleston, S.C.; Passaic, N.J.; Neenah, Wis.; Crawfordsville, Ind.; Peterborough, Ontario, Canada

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Most Versatile

Ruthman

GUSHER Coolant Pumps

MODEL UL 7120

Popular Model proved in performance by many leading machine tool builders

Gusher Coolant Pumps are available in a wide variety of models to fit almost any requirement. You can choose from immersed, pipe connected, and flange mounted for external or internal discharge in either motor or belt driven types. Tank mounted models for portable use are also available.

This United States #1 Hand Milling Machine manufactured by U. S. Burke Machine Tool Co. is equipped with a Gusher Coolant Pump.

Ruthman centrifugal pumps are also available as circulators, agitators, molten metal pumps. Write us your requirements. We will be glad to furnish you further information.

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AMERICAN CRUSHER

for uniform...low-cost reduction

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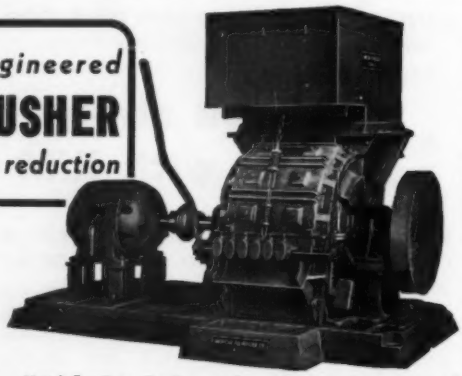
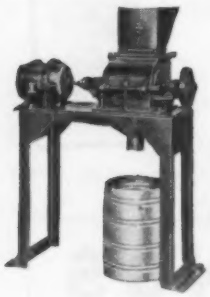


Metal Turnings Crusher—reduces long, curly turnings of steel, alloys, brass, aluminum, etc., to uniform chips for highest cutting oil recovery . . . increased scrap value.



Laboratory Mill—for testing pilot plant operation and waste reduction.

"AC" Ring Mill—with exclusive shredder rings—for uniform, high tonnage reduction. 500 TPH. "24 Series" ring or hammer crushers offer capacities to 50 TPH..... "30 Series" Hammermills to 100 TPH.

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Originators and Manufacturers of Ring Crushers and Pulverizers

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Forms Corporation

A newly formed corporation, Cleaver-Brooks Western Hemisphere Ltd., has been established to expedite marketing of Cleaver-Brooks products in the western hemisphere. Cleaver-Brooks, 326 E. Keefe Ave., Milwaukee, Wis., is a manufacturer of self-contained steam and hot water boilers, industrial oil burners, evaporators, distillation equipment, and heating equipment for road construction and ready-mix plants.

The new corporation will render service on Cleaver-Brooks products to all countries in the western hemisphere with emphasis on the Canadian, South American and West Indies' markets.

Appoints Representative

The Hammel-Dahl Company of Providence, R. I., manufacturer of automatic control equipment, announces the appointment of The E. B. Miller Co., 6636 Clayton Rd., St. Louis 17, Mo., as their new sales representatives in that territory.

Doubles Alloy Capacity

Allegheny Ludlum Steel Corp. has announced that it is in the process of doubling its capacity for refining high alloys and superalloy steels in consumable electrode vacuum remelting furnaces with the addition of two new furnaces at the Watervliet, N. Y. plant.

This would bring the number of consumable electrode vacuum furnaces to four with a total monthly rated ingot capacity of 500,000 lb, the company says. The superalloys and steels to come out of these furnaces will be used in making better jet engine parts.

Expand Canadian Operations

Metal & Thermit Corp., New York, and United Chromium of Canada, Ltd., Toronto, will combine Canadian activities under the name of Metal & Thermit—United Chromium of Canada, Ltd. Plans to construct new office warehouse and plant facilities in Toronto to house the joint operation have been announced.

Metal & Thermit, producer of tin chemicals, has sold a number of its products in Canada since 1918. Up to now, however, the company had not maintained local manufacturing or warehousing facilities in Canada. United Chromium, has maintained a resident organization in Canada since 1946 with offices and limited manufacturing facilities at 15 Emily St., Toronto.

For Consulting Engineers

turn to Page 164

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Appoints Sales Agents

The G. M. Wallace Co. of 313 Denham Bldg., Denver, Colo., and Dooley Bldg., Salt Lake City, Utah, will serve as sales agents for the complete line of Iso-Flow heaters in the states of Montana, Wyoming, Colorado, Utah, Idaho, and New Mexico (except Lea, Eddy, and Otero Counties), it was announced today by Petro-Chem Development Company, Inc., New York City. The company designs and builds the Petrochem-Isoflow furnaces which are used throughout the oil refinery, petrochemical, and chemical industries.

Moves Plant

The Palnut Co., manufacturer of Palnut lock nuts and fasteners, have moved to their new plant on Glen Rd., Mountainside, N. J., doubling the capacity of the plant facilities formerly occupied in Irving, N. J.

Opens Dayton Office

Norden-Ketay Corp. has opened an office on 11 W. Monument St., Dayton, Ohio.

Opens Memphis Office

Timken Roller Bearing Co. has established an office at 886 S. Third St., Memphis, Tenn. The new office and warehouse contains 6120 sq ft and provides parking space both in front of and in back of the new building. A complete range of tapered roller bearings to service the replacement trade will be carried.

Purchases New Division

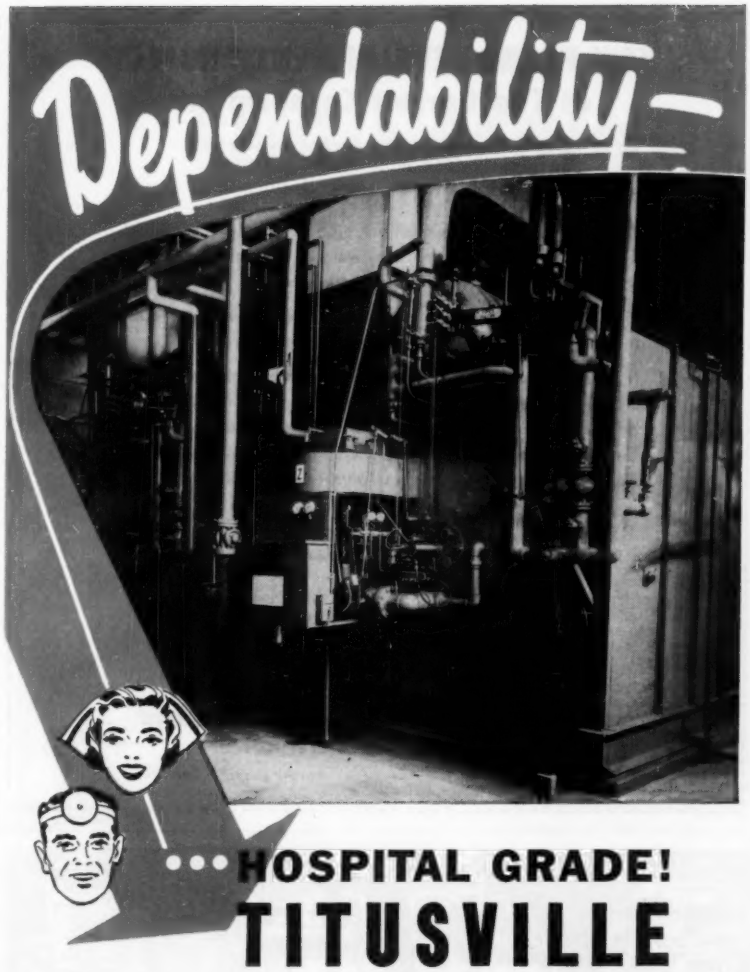
Republic Flow Meters Co., Chicago, has announced the purchase of the power plant equipment division of the Swartwout Co. of Cleveland.

Republic will take over the engineering, manufacture, sales, and service of the Swartwout line of desuperheaters, regulating valves, feed-water regulators, pump governors and air-operated controls.

Acquires Valve Firm

As its fourth major acquisition within six months, Walworth Co. manufacturer of valves and pipe fittings, has completed purchase of all of the outstanding common stock of the Conoflow Corp., Philadelphia, a producer of pneumatic automatic valve control equipment. Conoflow will be operated as an independent subsidiary without change in management, employees, or present policy.

Previous acquisitions as operating subsidiaries include M & H Valve & Fittings Co., Anniston, Ala., maker of valves and fittings for industrial sprinkler systems, waterworks and sewerage systems; Alloy Steel Products Co., Inc., Linden, N. J., manufacturer of stainless steel valves; Southwest Fabricating & Welding Co., Inc., Houston, Tex., fabricator of carbon and alloy steel pipe for the gas, petroleum, and petrochemical industries.



Write for your copy of the latest Titusville WTP Catalog

The wide load variations encountered in hospital service are handled smoothly and dependably by the fully automatic, fully modulating features of Titusville's WTP Steam Generator. Shown are two Type WTP #12.5 units, serving a large eastern hospital with high efficiency over the entire operating range.

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BOILERS for Power and Heat . . . High and Low Pressure . . . Water Tube . . . Fire Tube . . . Package Units

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Crystallizers . . . Direct Fired Heaters . . . Evaporators . . . Heat Exchangers . . . Mixing and Blending Units . . . Quick Opening Doors . . . Special Carbon and Alloy Processing Vessels . . . Synthesis Converters

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MACHINERY for Sheet and Structural Metal Forming . . . Tangent Benders . . . Folding Machines . . . Roller Table and Tumble Die Bending Machines . . . Press Brakes . . . Punching and Notching Machines . . . Forming Dies

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Titusville, Pennsylvania
Manufacturers of A Complete Line of Boilers for Every Heating and Power Requirement
Plants at Titusville, Pa. and Warren, Pa.
Offices in Principal Cities

NEW PRIME DEVELOPMENT PROJECT at The Garrett Corporation

Newly formed Rex division has immediate openings for Turbomachinery Specialists — unusually interesting, unusually promising.

This is a prime development program which will interest Turbomachinery Engineers who welcome a "ground floor" opportunity with no ceiling on advancement.

This new Garrett division has tremendous growth potential for the engineering staff now being formed.

If you are qualified by experience, are eligible for secret clearance, and are interested in any of the following categories in design, development or drafting, please write for further information to: Robert L. Ehinger, Rex Division, 9851 So. Sepulveda Boulevard, Los Angeles 45, California.

Mechanical Design	Combustion
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Stress	Aerodynamics
Vibrations	Testing
Gears	Instrumentation
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Pumps	Lubrication
	Seals

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REX DIVISION
Los Angeles 45, California

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Large "ECLIPSE" 9-Cyl. Compressor
"ECLIPSE" Compressors, 2, 3, 4, 6 or 9 Cylinders
Small Ammonia & Freon-22 Compressors
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Most comprehensive line of compressors in the Industry. There's one to meet the needs of your business exactly. Handle any commercial or industrial load, at any temperature, with any refrigerant! Get the full facts and figures now: write, wire or phone
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Booster Compressors for Low Temperatures
Combined Ammonia Units in 3 Sizes
Large 2-Cyl. Ammonia Compressors
Large 4-Cylinder Compressors—Up to 700 Hp.

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Expands Fan Line

Plans for an expanded line of fans and blowers and increased production volume are under way at Peerless Electric Co., Warren, Ohio, with production starting in the firm's new $350,000 Fan and Blower Div. plant.

The firm predicted that it will soon be producing about 400 different models of fans and blowers. Most new models will be of a larger size than the firm presently manufactures. The company's current line amounts to about 250 fans and blowers, covering 10 to 15 general types.

Moves Offices

American Engineering Co. announces the removal of its main offices from Aramingo Ave. and Cumberland St. in Philadelphia's Kensington district to a newly completed office building in the Frankford district. The new address is Wheatsheaf Lane and Sepviva St., Philadelphia 37, Pa.

Distributor Appointed

Adamas Carbide Corp., Kenilworth, N. J., has appointed Ellsworth Steel & Supply Co., Stratford, Conn., as its stocking distributor for its line of carbide tools and tool tips.

Valve Plant Sold

The Lunkenheimer Co., Cincinnati, Ohio, has sold its Carthage plant, which was formerly devoted to the manufacture of iron and steel valves. The firm's iron and steel valve operations are being transferred to a new brick-concrete and steel building on a site adjacent to its Fairmount plant in Cincinnati.

Opens Midwest Branch

Creation of Vickers Inc., Midwest Branch, a new facility for service, repair, warehousing and custom production activities, is announced.

The new 18,000 sq ft building is located on S. Kildare at Fillmore, Chicago, Ill. The Midwest Branch will provide users of oil-hydraulic systems in Wisconsin, North Dakota, Minnesota, northern Illinois and northwestern Indiana.

Materials Handling Agent

W. W. Munroe Co., has been appointed a distributor for the industrial materials handling trucks of the Baker-Raulang Co., Cleveland. Munroe has sales and service facilities at 728 Evans Ave., St. Louis, Mo., and will shortly expand into a new building where a complete stock of Baker parts and demonstration trucks will be carried.

The line to be handled includes gasoline, electric, and gas-electric fork and platform trucks, Shoveloader for bulk materials handling, and Traveloader side-loading fork truck. Munroe's territory will include southern Illinois, eastern Missouri, and metropolitan St. Louis.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Purchase Broadens Fuller Line

Fuller Co., Catasauqua, Pa., has acquired all of the outstanding stock of the Sutorbilt Corp., Los Angeles, Calif.

Sutorbilt has for many years been a manufacturer of positive pressure blowers, pneumatic conveyors, fans, material feeders, and related products. It operates two manufacturing plants in Los Angeles. The positive pressure blowers manufactured by Sutorbilt broaden the line of air compressors and vacuum pumps now manufactured by Fuller, and enlarge its market in industry, as well as in water purification and sewage disposal plants, and for ventilating large tunnels.

LATEST CATALOGS

Special Steels

A booklet entitled "Special Steels for Industry" is being distributed by Allegheny Ludlum Steel Corp. 2020 Oliver Bldg., Pittsburgh 22, Pa. This 16-page booklet gives details as to stainless steels, electrical materials, Carmet carbide materials, and tool steels manufactured by the organization.

Numerous charts giving analysis of various steels as well as detailed information on fabrication and properties are included in the booklet.

Cast Iron Welding

A new, fully illustrated four-page booklet entitled, "The Repair of Cast Iron Parts," has recently been issued by The International Nickel Co., Inc. It outlines the latest information on the welding of cast iron with Ni-Rod and Ni-Rod "55." Nine graphic case histories show the welding electrodes in action.

The booklet is available through the Readers Service Section of The International Nickel Co., Inc., 67 Wall St., New York 5, N. Y.

Deflection Indicator

Magnetic-amplifier type deflection indicator, applicable to any equipment in which early detection of relative movement is desirable, is described in a new eight-page bulletin released by Allis-Chalmers Mfg. Co., 949 S. 70th St., Milwaukee, Wis.

The indicator is designed to safeguard hydrostations, compressor and pumping stations, drive shafts and other applications. A 60-cycle, 110-v power source and a suitable location for mounting two compact inductor-coil pickup units are its only requirements. The indicator offers potentials for both remote and local operation, the company says. In either instance, visual or audible alarm systems can be activated to call attention to deflection or motion.

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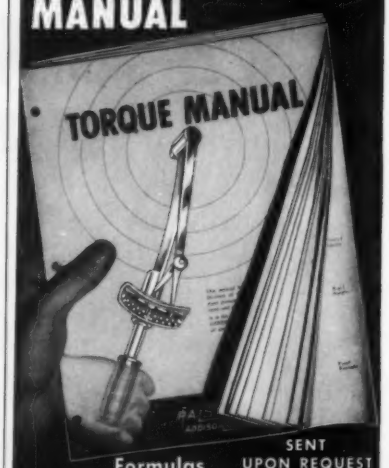

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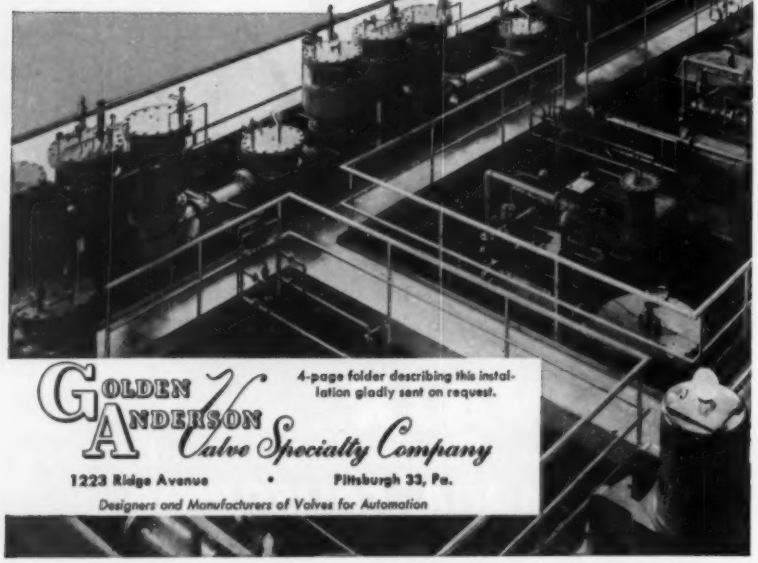

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Ceramicast Bulletin

Lebanon Steel Foundry, 114 Lehman St., Lebanon, Pa., has published a four-page bulletin on Ceramicast, its new process for producing close tolerance steel castings from ceramic molds.

The bulletin traces the history and principles of the process and illustrates several of its major applications. Advantages of quality, cost, and versatility are discussed.

Expansion Joints

Cook Electric Co., 2700 N. Southport Ave., Chicago, Ill., has issued a new catalog on HydroLastic expansion joints. This 24-page catalog, No. 53, gives details of construction and specifications together with directions for ordering and application data for various piping systems.

Annunciator Selection

Scam Instrument Corp., 3855 N. Kedzie, Chicago 18, Ill. has released a 26-page manual-catalog that describes its line of annunciator alarms and presents practical information on the selection, application, and proper function of annunciators throughout the industry. The company says it is a guide book for any enquirer confronted with monitoring problems, containing design and specification data on the firm's De-line, Du-all line, S-line, plug-ins, and accessories.

Trailer Suspension

A. O. Smith Corp., Truck and Trailer Products, 5715 Smithway St., Los Angeles 22, Calif. has issued Bulletin T-1 describing design features of its "5th wheel" suspension for truck trailers.

Giant-sized synthetic O-rings are used instead of heavy steel springs. The company says this, plus other design features, results in weight savings of approximately 400 lb.

Conveyor Idler

The new Link-Belt Series 50 ball bearing belt conveyor idler, which offers economic advantages in both original investment and operating requirements, is described and pictured in Folder 2516. New from base to ball bearings, the Series 50 idlers are available in two types, greaseable and factory sealed, for seven belt widths ranging from 14 to 36 in. For a copy of Folder 2516, write to Link-Belt Co., Dept. PR, 307 N. Michigan Ave., Chicago 1, Ill.

Lubrication Controls

An illustrated four-page circular, describing its line of constant level oil controls; bottle oilers for plain bearing lubrication; glass body oil cups; and aluminum body oil cups, has been prepared by the Lunkenheimer Co., Box 360, Cincinnati 14, Ohio.

The circular includes detailed dimensions and installation instructions covering a wide range of applications.

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KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Fire Detection

Automatic Sprinkler Corp. of America, Youngstown, Ohio, has issued a 28-page catalog, No. 73, covering various methods of fire detection, fire prevention, fire control and fire extinguishment.

Included are applications of the firm's water and chemical sprinkler systems, data on installation and application, and a chart of special fire hazards and the proper equipment recommended to guard against them.

Plastic Laminate

A bulletin describing a new lining material that can be applied to inexpensive containers, tanks, pipes, etc., is offered by The Garlock Packing Co., Palmyra, N. Y.

The lining material is a laminate of Kel-F plastic fused and flowed into a glass fiber cloth backing. Conventional adhesives can be used to apply the laminate to practically any contoured surface, and it can be applied to large tanks and vessels right on-the-job without moving them to an applicator's shop.

The characteristics of the laminate include extreme chemical resistance to acids, alkalies, oxidants, and solvents; non-toxic; high abrasion resistance, tensile strength, dielectric strength, and electrical resistivity; high and low temperature resistance; nonsticking, nonwetting surface, and low temperature flexibility.

High Speed Steels

A new, expanded edition of the Blue technical data sheet on "The Working of Tool and High Speed Steels" is now being distributed by Allegheny Ludlum Steel Corp., 2020 Oliver Bldg., Pittsburgh 22, Pa.

This 16-page booklet has 17 charts giving detailed information on these steels. Such items as cutting tool angles, table of cutting speeds, temperature ranges and guides are included in the booklet. Heat treating, design, machinability, and other subjects are also treated.

Wire Drawing Machines

An eight-page booklet published by Waterbury Farrel Foundry & Machine Co., Waterbury, Conn., illustrates and describes continuous tandem wire drawing machines. Those covered include the drum type, block type and combination type for drawing brass, copper, aluminum, and other nonferrous metals.

The bulletin contains illustrations of machines with various types of drive and packaging arrangements. The features described in the text include construction and drive, die holders, drawing rolls, machine lubrication, die lubrication, four speed block drive, capacity and speed, accessory equipment and pooling. Tables of specifications for 10 and 12 die machines and a floor spooler are given. The booklet also lists other types of wire drawing and flattening equipment built by the firm.

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Here, in six big sections are: Criteria for facing the over-all problems of selection of materials; facts on potential weaknesses of various metals and ways of making the metals strong; details of the specific problems of corrosion and the mechanical factors which influence corrosion; present knowledge of testing by nondestructive methods; the special requirements of design and surface finish set up by mass production; modern basic information on design theory, design practice, experimental design, and the special requirements of aluminum and magnesium.

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In convenient chart and table form, the book brings data on AISI steels, ASTM steels, cast copper alloys, aluminum alloys, tin, magnesium, etc. It provides a practical fund of working data from the end-quenched hardenability of steels to the weldability of aluminum alloys and heat working temperature of copper alloys. It tabulates, under each of the more than 500 metals listed, its chemical composition, brittleness, heat treatment, and other characteristics; industrial uses; treatment temperature for forging, annealing, quenching, etc.; such technological properties as recrystallization temperature and hot working temperature; and a great deal of other pertinent information.

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29 W. 39 St., New York, 18

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Resilient Bearings

Lord Mfg. Co., 1635 W. 12th St., Erie, Pa., has issued Bulletin No. 703 covering its Dynaflex joints used as resilient bearings at pivot points.

Included in the bulletin are diagrams of typical installations on a load equalizer beam, spring eye, steering axle and torque rod joint on various heavy vehicles.

Heavy Duty Bulk Scales

A two-color, six-page bulletin describing three models of the Class 38 automatic weighing unit for bulk materials is offered by Richardson Scale Co., Clifton, N. J.

These heavy duty scales are designed for handling dry, ground, granular, dusty and non free-flowing materials such as ground feeds, salt, coffee, malt and similar products. The bulletin discusses construction, operation, feeding arrangements and capacities for the scales. Gravity, belt, screw and vibrating feed arrangements are shown in diagram. Special features such as hopper door flapper, locking gear, automatic compensation mechanism and automatic tabulator are described and illustrated. A complete line of accessory equipment, including a pneumatic gate assist, residue beam, remote electric counter, and agitators are discussed.

Hydraulic Systems

"Trouble-shooting Chart for Hydraulic Systems" is the title of a new wall chart offered by Sun Oil Co., 1608 Walnut St., Philadelphia 3, Pa.

This two-color chart, is designed for display in shops to help operators and maintenance men spot and cure common troubles.

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KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Lubricated Plug Valves

"Powell Lubricated Plug Valves," a 36-page catalog, PV-4, shows in detail the line of iron and steel lubricated plug valves available from Wm. Powell Co., Cincinnati 22, Ohio. Many illustrations of the single, screwed and bolted gland type valves are shown, including photographs, sectional and detailed drawings. Also included is physical data on dimensions and ratings.

Electrostatic Precipitators

Koppers Co., Inc., Metal Products Div., Baltimore 3, Md., has issued a four-page folder on its individually designed electrostatic precipitators for cement dust collection.

Sections of the folder deal with electrode design, rapping mechanism, gas distribution, dust removal, power equipment, and automatic power regulation.

Heat Transfer Data

A new heat transfer bulletin recently issued by Downingtown Iron Wks., Inc., Downingtown, Pa., contains data and illustrations of interest to designers and users of custom-built heat transfer equipment. Included are a table of heat transfer rates for various duties, tube sheet layout tables and a sample calculating sheet. The 16-page bulletin also illustrates and describes a number of heat exchanger types designed and built by Downingtown Iron Works. Ask for Bulletin HE.

Another new bulletin illustrates and describes the facilities of Downingtown Iron Wks. for fabricating towers, columns, pressure vessels; heat transfer equipment from steel, stainless steel and many other metals and alloys; and bulk storage tanks and delivery trucks for the LP-Gas industry. Copies of this four-page bulletin are also available. Ask for Bulletin DIW.

Plastic Insulation

A new 12-page technical brochure on "Haysite", a glass reinforced alkyd base polyester insulating material, is now available from the Reinforced Plastics Div., Hays Mfg. Co., West 12th St., Erie, Pa. The brochure contains a complete characteristics chart, comparison charts, and information on applications for this new material.

Crane Electrification

Catalog No. 2021-A is offered by Cleveland Crane & Engineering Co., Wickliffe, Ohio, on its line of inverted-Y electrification, which is now being made available for the first time for application on all makes of cranes and runways.

The booklet contains drawings and all catalog information necessary for ordering the aluminum inverted-Y conductors, supports, and collectors for any normal application requiring current in amounts of 300 to 1000 amp.

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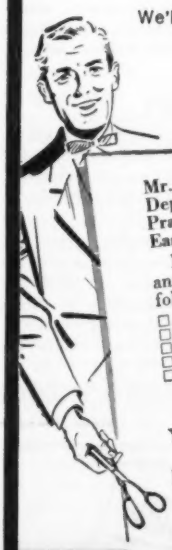

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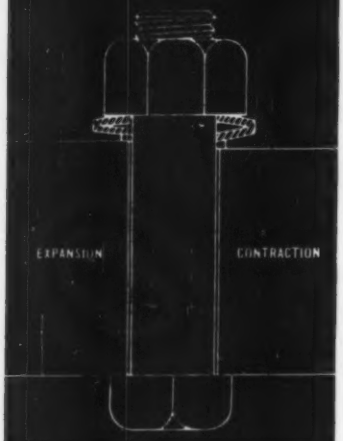

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KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Continuous-Cast Bronzes

New 5- to 9-in. diam Asarcon 773 continuous-cast bearing bronze, SAE 660, and the savings accruing in factory maintenance and production by virtue of advantages the product offers in length, size, machining time, metallurgical superiority, and physical properties are described in six-page bulletin, No. 301, issued by the Continuous-Cast Products Dept., American Smelting and Refining Co., Perth Amboy, N. J.

The bulletin brings together in tabular form all stock sizes and weights of solid and hollow bronze bars from 1/2 to 9 in. in diam. The patented Asarco continuous-cast process by which a variety of copper-base alloys is cast into rods, tubes, and shapes of many different diameters and profiles, formerly available as foundry castings only, is described.

Wet Pit Pumps

A 16-page catalog No. 3007 has been published by Yeomans Brothers Co., 2006-1 N. Ruby St., Melrose Park, Ill., covering the company's line of heavy duty wet pit pumps for such applications as drainage, flood water, effluent boiler blow-off, hot wells, acids and alkalis.

More than 30 pictures, drawings, tables and curves discuss and describe design features of the pumps, and suggest applications for which the pumps have been successfully used. The catalog also carries a condensed version of the "Standards of Hydraulic Institute" data section which lists various metals used in constructing pumps for handling various different liquids.

Ultrasonics for Industry

An eight-page bulletin covering application of the ultrasonic Reflectoscope for nondestructive testing of products and equipment, has been published by Sperry Products, Inc., Danbury, Conn.

Designed by Sweet's Catalog Service for maximum readability, the bulletin pictorially illustrates many uses of the Reflectoscope. It also explains in simplified terms the principle of ultrasonic inspection as well as illustrating the latest types of equipment available. Industries where the device can be useful include aircraft, automotive, iron and steel, metal working.

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KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Welding Manual

Linde Air Products Co. Div., Union Carbide and Carbon Corp., 30 E. 42 St., New York 17, N. Y., has issued a bulletin on manual or mechanized SIGMA (shielded inert gas metal arc) welding, in which an arc between the consumable wire electrode and the workpiece is maintained in an atmosphere of inert gases, principally argon.

The gases shield the weld zone from possible contamination by contact with air and eliminate the need for flux. The firm says X-ray quality welds can be produced by either manual or machine welding. Application photos of the process are included in the manual.

Production Screws

Bergander Mfg. Co., 2129 Warner Ave., Chicago 18, Ill., announces the availability of a catalog illustrating and describing its Gulmite screws, nuts, finishing washers, and tools.

The screws are manufactured in all standard types and are provided with round head, low round head, oval head with countersink, flat head, and fillister head styles. The screws have serrated edges rather than slots and are applied either by hand or power wrench-like screw drivers.

Speed Reducers

Details on the firm's line of shaft mounted reducers are presented in Bulletin CD-400 released by Cone-Drive Gears Div., Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, Mich.

Dimensioned assembly drawings, hp and torque rating charts, and application photographs illustrate the new 12-page, two-color booklet. Complete specifications on bore sizes and gear mountings plus mounting instructions are included.

Any shaft mounted speed reducer is readily motorized through use of a simple bell housing adapter that accommodates NEMA C-type flange motors from 1/8 to 10 hp. All necessary dimensions and details for motorizing are provided in the new bulletin.

Portable Transfer Unit

An illustrated four-page bulletin describing the Airslide transfer unit, a portable unit for unloading bulk flour, is now offered by the Fuller Co., a subsidiary of General American Transportation Corp., Catasauqua, Pa.

Three photos in the bulletin show the transfer unit at work in its twofold function: unloading flour from a bulk railroad car to a bulk flour van, and unloading from the van to storage bins at a commercial bakery. Two diagrams show how the portable unit can be used with pneumatic pressure equipment, either for car-to-van unloading, or for direct car-to-bin unloading when the bakery is located at a siding.

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KEEP INFORMED

NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Thread Plug, Ring Gages

A 32-page catalog on thread plug and ring gages, believed to be the most complete and informative of its kind, has been issued by the Besly-Welles Corp., Besly-Metro Gage and Tool Div., Beloit, Wis.

Included is a four-page illustrated visual index, for finding and selecting proper gages for every application. Tables of sizes and prices for each type gage is presented on thread plug, thread ring, thread setting plug, plain cylindrical plug, plugs and rings, and master setting disks followed by American Gage Design Standards specifications. Information on the use and selection of gages is also included.

Self-Tapping Inserts

A new booklet, published by Groov-Pin Corp., Ridgefield, N. J., describes the Tap-Lok insert and its uses. This self-tapping bushing is threaded inside and out and has cutting edges that enable it to be installed in a drilled or cored hole in a single operation. It is extensively used to provide a firm base for threaded fastenings in non-ferrous metals and materials where threads tapped directly in the parent material would not have adequate strength.

Machinery Bulletin

Watson-Stillman Press Div., Farrel-Birmingham Co., Inc., Aldene Rd., Roselle, N. J. has announced the availability of a new general bulletin on its complete line of machinery. Included in this 24-page bulletin is detailed information on injection, compression, and transfer molding machines for the plastics industry; extrusion presses for ferrous and non-ferrous metals; metal-working equipment; railroad shop equipment; ordnance equipment; and standard and special machinery for general industrial applications.

Iron Powders

Bulletin No. 2, recently published by Plastic Metals Div., National-U.S. Radiator Corp., 342 Madison Ave., New York 17, N. Y., describes and illustrates the processes used to manufacture electrolytic and reduced iron powders.

The 12-page bulletin lists their many uses in manufacturing commercial and industrial products, and shows many of the intricate mechanical and electrical parts made from these powders. Also included is descriptive information on other metal powders supplied by the company.

Aluminum for Heat Exchangers

A brochure has been issued by Reynolds Metals Co., 2500 S. Third St., Louisville, Ky. to provide data on use of aluminum in heat exchangers.

The brochure points out that aluminum offers lower cost, corrosion resistance, maximum heat transfer rates, temperature properties, non-fouling, lower maintenance and light weight. Included are listings of some of the materials that can be handled satisfactorily in aluminum, and a listing of the recommended alloys for heat exchanger components. Maximum allowable stress values, according to the ASME boiler codes (1952), are shown in a table in the Specification Information section.

Portable Lifts

Its new line of multi-purpose, manually propelled, hand- and battery-powered hydraulic lifts with capacities from 500 to 2000 lb, are illustrated and described in an eight-page brochure, released by Oster Mfg. Co., E. 289 St., Wickliffe, Ohio.

A unique design provides four carriers in one: a platform truck, a straddle fork truck, a portable elevator, and a shop crane. Exclusive features include adjustable legs which allow the carrier's legs to ride straddling the load or beneath the load as required; new design adjustable forks; and remote control as standard equipment at no additional cost on power operated models.

Insulating Castables

J. H. France Refractories Co., Snow Shoe, Pa., has announced publication of a new single sheet service bulletin on Hydrecon insulating castables for industrial and domestic furnace linings.

Included in the catalog is a breakdown in tabular form of recommended use limits, pounds required per cu ft, permanent linear change (212 F, 1200 F, 1750 F, and 2220 F), modulus of rupture and thermal conductivity of light weight insulating castables 512 and 2400. In addition to thermal conductivity graphs and photos illustrating the use of the products in application, a special section is devoted to three allied insulating products, light weight plaster, semi-lite weight and Franco-lite cast block mix. Special sections are devoted to the selection of insulating Hydrecons and use recommendations.

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NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Wear-Back Fittings

Data Sheet Wc, from Allen-Sherman-Hoff Co., 259 E. Lancaster Ave., Wynnewood, Pa., describes the company's line of one-piece, abrasion-resistant, wear-back fittings. These are designed primarily for hydraulic materials handling systems, but can also be used for pneumatic handling.

The two-page sheet, entitled "Ashcolite Integral Wear-Back Fittings," illustrates three styles of elbow fittings and a lateral fitting. Details of construction and advantages are covered. Line diagrams with dimension tables give pertinent size data.

Precision Gear Boxes

A series of flexible, precision-made gear boxes for use in actuators, computers and small electronic components are described in an illustrated catalog sheet issued by Southwestern Industries Inc., Centinela Ave., Los Angeles 45, Calif.

Designated Series 145 and 167, the gear boxes provide maximum torques from 150-oz in. to 200-oz in. with high efficiency and low backlash. They are designed for mounting directly to small electric motors, and can be supplied with an input shaft if desired. Ball bearings are used throughout. Complete specification tables of both gear box series are included in the catalog sheet.

Automatic Lubricators

A four-page, two-color brochure, Bulletin 3A, describing "high-pressure" automatic lubricators is offered by Bijur Lubricating Corp., 151 W. Passaic St., Rochelle Park, N. J.

This line of lubricators is said to be applicable to such machines as printing presses, machine tools, packaging, labeling and bottling machines, and many other types of machinery. Designated Type "A," the automatic lubricators deliver metered quantities of oil on adjustable time cycles. The bulletin describes in detail the cam mechanism that controls cycling. Two basic types, AA for frequent cycling and AB for infrequent cycling, are discussed in terms of feed requirements for specific machines. Two tables enumerate lubricators available for five basic drive speeds.

Fan Catalog

The Trane Co., manufacturing engineers of air conditioning, refrigeration, heating, ventilating and heat transfer equipment, has just published a catalog covering Class III fans, especially designed for high velocity air conditioning systems. The fans are also ideally suited for industrial use.

Air capacity ratings for the fans range in static pressure from 5 to $11\frac{1}{2}$ in. in $\frac{1}{2}$ in. increments, with a total high pressure limit at $12\frac{1}{4}$ in. The fans are cataloged in single and double width arrangements, in sizes 18 to 73.

Trane Class III fans have extra sturdiness built in to offset the added stresses on fan components as a result of the higher speed they must operate at in order to develop the higher pressures. Shafts and bearings are larger, wheels are heavier and housings more rigidly reinforced. The fans are of heavy box type construction with scroll sheet welded to side sheets. Bearings are heavy duty, ball or roller type, depending on the fan size, assuring many years of trouble-free service. If preferred, oil ring lubricated sleeve bearings can also be furnished.

All accessories for the Trane Class III fan line, such as dampers, inlet vanes, access doors, are built extra rugged to conform to the basic construction features of the fan itself. If desired, Class III fans can be made of spark-resistant construction in the various standard types, and can also be made for high temperature applications.

For further details about fan bases, drives, motors, etc., write to Trane, La Crosse, Wis., for Bulletin DS-348-C.

ROCKFORD

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MORE Clutch Life (400% MORE)
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NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Leak Detector

A 20-page bulletin, No. 1301, of interest to engineers and maintenance personnel of municipalities, public works and water works dealing with water conservation and water wastage, has been prepared by the Simplex Valve & Meter Co., Lancaster, Pa.

Describing the Simplex pitot assembly, consisting of a pitot rod, manometer, and pitot recorder, this equipment is used to locate hidden leaks in water mains which waste thousands of gallons per day per mile or main. Valuable data on care of equipment, installation instructions, theory of operation and formulas is contained that will help to reduce "unaccounted-for-water" to a minimum.

Passenger Conveyor Bulletin

Stephens-Adamson Mfg. Co. of Aurora, Ill., announces the availability of their new Speedwalk passenger conveyor system brochure. This eight-page bulletin includes photographs of existing installations as well as basic design and application data. In addition, numerous artists sketches illustrate possible applications for this new system of passenger transportation. Also covered in the Speedwalk bulletin is the Stephens Adamson Goodyear Carveyor system which proposes to handle passengers in small cars riding on belts at speeds up to and above 15 mph. For your copy of the S-A Speedwalk bulletin, write the company.

Push Insert

A new, four-page bulletin, No. 731, has been announced by the Heli-Coil Corp., Danbury, Conn., illustrating and describing the PIP push insert, newest addition to the Heli-Coil line of screw thread inserts. The PIP push insert provides female threads in molded plastics, laminates, die-cast alloys, powdered metals and light metals in a drilled or cored hole without tapping, at low cost in large quantities. The insert is pushed into the hole and is not wound or turned. The new bulletin gives size ranges available, installation techniques and an application chart.

Stainless, Alloy Fittings

Engineering data and size dimensional information on forged stainless and alloy steel fittings has been included in an eight-page bulletin, S-1-55, published by Watson-Stillman Fittings Div., H. K. Porter Co., Inc., Box 95, Roselle, N. J.

The alloys covered include types 304, 316 and 304 L stainless steel; 1 1/4 per cent chromium—1/2 per cent molybdenum steel; 2 1/4 per cent chromium—1 per cent molybdenum steel and 4–6 chrome 1/2 per cent Moly fittings.

The forged stainless and alloy steel fittings are used for high temperature and corrosive applications in the petroleum, chemical and other process industries and in power plant high pressure-high temperature steam piping.

Drafting Techniques

A new booklet called "11 Ways to Save Drafting Time" is now available without charge from Frederick Post Co., 3666 N. Avondale Ave., Chicago 18, Ill. The company says it's the first booklet that compiles the many ways of using intermediates to make quick modifications of drawings without changing the original.

The booklet discusses 11 specific ways to use intermediates, with each of the time-saving techniques clearly illustrated. Brief copy covers every step of the process. Among topics covered are scissor editing, masking, the block-out method, successive additions and pre-printing. Other methods shown are transparent matte tape, pick-off transfer, composite grouping, composite overlays, nonreproducible blue, and the use of corrector fluids. The techniques described apply to various print-making methods such as moist-developed process, ammonia process, blueprint, sepia negative and even reproduction cloths in some instances.

Reversing Motors

"Louis Allis Rapid Reversing Motors," is the title of a new bulletin just released by The Louis Allis Co., manufacturer of electric motors, drives, and generators.

Featured in the bulletin is a cutaway view showing the construction of a blower-cooled, rapid-reversing motor capable of more than 200 idle reversals per min. Engineering information given consists of formulas on inertia and motor reversal calculations. This information will be useful to anyone who has a use for this type of motor.

Copies of this informative new bulletin, No. 1800, can be obtained by writing to The Louis Allis Co., Milwaukee 7, Wis.

Synthetic Fluids

A new 52-page booklet on Ucon synthetic fluids and lubricants has been issued by Carbide and Carbon Chemicals Co. Div., Union Carbide and Carbon Corp., 30 E. 42nd St., New York 17, N. Y. The booklet covers properties, applications, and characteristics of these polyalkylene-glycol derivatives.

The fluids and lubricants are described as having established uses as mechanical lubricants, hydraulic fluids, rubber and textile lubricants, heat-transfer fluids, anti-foam agents, solvents, and formulation components. They are supplied in both water-soluble and water insoluble series, with or without additives. Viscosities range from 50 to between 60,000 and 90,000 Saybolt Universal Seconds at 100 F. Their physical characteristics are different from those of animal, vegetable, and mineral oils. They have high viscosity indexes, low pour points, and excellent lubricity. They are wax-free, noncarbonizing, sludge resistant, and noncorrosive to metals. They have little or no effect on rubber.

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Precision Castings

A new five-page folder, detailing its facilities, policies, and personnel, is now available from the Engineered Precision Casting Co., Box 68, Matawan, N. J.

The literature, which was occasioned by the 10th anniversary of the company, highlights the major events during the growth of the firm, illustrates its key personnel, and details its recently introduced tooling charge rebate plan.

Roofing Fasteners

A four-page folder describing the use of Tuff-Tite fasteners for economical, leakproof application of roofing and siding materials has been published by Townsend Company, New Brighton, Pa.

The folder gives details on how the design of fasteners with assembled Neoprene washers makes possible an effective watertight seal when applying roofing and siding of aluminum, galvanized, or stainless steel, protected metal, fiberglas, plastic, and insulated panels. Featured in the folder is a cross-sectional diagram which shows how the undercut in the unit's one-piece metal head controls the flow of the washer on concave or convex surfaces.

Water Chillers

Trane Co., Lacrosse, Wis., has issued Bulletin DS-399, giving data on the company's range of "CenTraVac" centrifugal refrigeration equipment, which is used to provide chilled water for air conditioning and refrigeration systems.

The 50-page bulletin provides engineering and capacity information on 20 sizes, including 6 new models in the 400 to 600 hp range. Information on 8 new models in the 50 to 300 hp range is also given. Typical installations of this automatic, hermetic water chiller are shown, as are numerous cutaway views of the machine and pictures of its basic component parts.

Xerographic Copying

A six page brochure designed for present users of xerographic copying equipment has been announced by Haloid Co., Rochester 3, N. Y. The brochure illustrates and describes some of the most important developments since xerography was first announced in 1950, which means lower costs per copy, fewer operations and less labor, and higher quality in the finished product as shown by sharper, blacker, and denser images.

Pump Bulletin

Type M pumps for medium and high head services are described and illustrated in an eight-page bulletin issued by C. H. Wheeler Mfg. Co., 19th and Lehigh, Philadelphia 32, Pa.

Advantages of high efficiency and low maintenance are described. Cross sections of design are shown for bottom suction and side suction types. Construction details are included.

Chromium Impregnation

A reprint entitled "Chromium Impregnation for Corrosion Resistance and Heat Protection" is available from the Chromalloy Corp., 450 Tarrytown Rd., White Plains, N. Y. It describes a number of the advantages derived from Chromallizing, a relatively new process for increasing the heat, wear, and corrosion resistance of ferrous and certain nonferrous metals by high temperature diffusion of chromium into the surface.

The four-page illustrated reprint contains specific applications, properties, recommended steels, and information on heat treatment, forming, finishing, and joining.

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Acushnet labs selected natural rubber as the compound that would remain flexible permitting push button movement and still resist detergent and soap action.

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Steatite Ceramic

Star Porcelain Co., 158 Muirhead Ave., Trenton 9, N. J., manufacturer of electrical porcelain, announces the availability of three revised catalog sheets on standard parts available in Star Lavolain, a steatite ceramic for high temperature insulation with high dielectric and mechanical strength.

Catalog Sheets 400, 600 and 700 contain specifications on center shoulder bushings, insulating washers and bushings, and insulating shoulder bushings.

Magnet Materials

Indiana Steel Products Co., Valparaiso, Ind., has issued Manual No. 5-R, "Permanent Magnets Materials and Their Selection."

Types of materials discussed include: cast—Alnico I, II, III, IV, V, VI, XII; sintered—Alnico II, IV, V and VI, Indalloy, and Indox; ductile—Cunife I and Cunico; and formed—chrome and cobalt steels. A new selector-type chart summarizes the magnetic characteristics, application and design factors, material characteristics, manufacturing methods and shapes limitations of each material.

Adhesives, Coatings

A new 12-page, two-color, illustrated catalog listing properties and applications of a wide variety of adhesives, coatings and sealers is now available from Adhesives and Coatings Div., Minnesota Mining & Mfg. Co., 411 Piquette Ave., Detroit 2, Mich.

Typical applications for adhesives, coatings and sealers in the metalworking, transportation, general manufacturing, electrical manufacturing and building products industries are listed in comprehensive tables in the catalog. General information on materials, techniques, services and selection are included on the first two pages of the catalog.

Alloy Steel

A new booklet on "T-1" steel, described as a high-strength, readily welded, weight saving alloy steel, has been announced by Lukens Steel Co., Coatesville, Pa.

The bulletin uses charts, graphs, sketches, and photographic illustrations in describing this engineering material, which is available in thicknesses from $^3/_{16}$ to 6 in., and above and in standard widths up to and including 195 in., with a maximum length of 720 in.

Mill Instrumentation

Instrumentation systems for pulp and paper mills are described in a new 32-page illustrated catalog, published by Fischer & Porter Co., 626 Jacksonville Rd., Hatboro, Pa.

Systems for 24 sections of various types of mills—from cooking liquor preparation to wet-end control—are covered. A flow diagram and description of each separate operation is accompanied by photographs of typical control systems installed in various paper mills throughout the world.

Heat Exchanger

An improved design heat exchanger, Type "BD," is described in new bulletin supplement, 12-HS, released by Schutte and Koerting Co., Dept. HT-D, Cornwells Heights, Bucks County, Pa.

The unit is made in single- and two-pass designs for the petroleum, power and chemical processing industries. The supplement describes both types and includes data on features, construction, and materials of construction. Sizes available and dimensions of single- and two-pass designs are given in tabular form.

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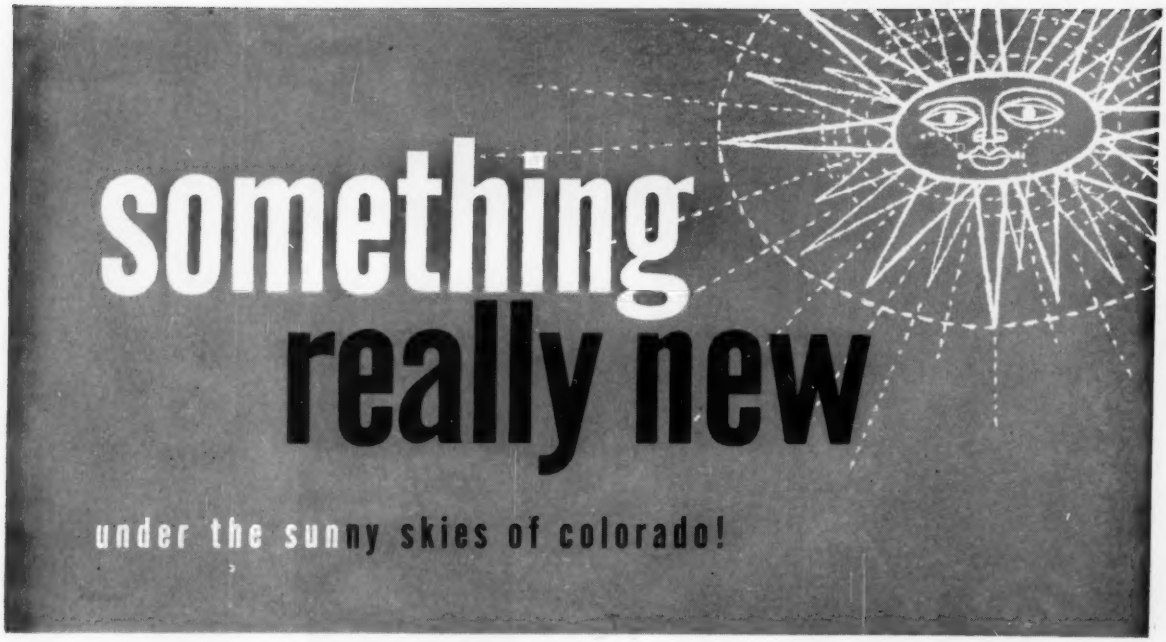

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Between the limits of —100°F. and +1000°F., with operational spans of 50°, 100°, 200°, and 400°F, this rugged, highly responsive instrument performs outstandingly under the most severe conditions. It is compensated for ambient temperatures and pressure. Derivative action can be furnished for optimum performance when substantial thermal or transmission lags exist.

With its weatherproof housing and integral mounting bracket, it can be installed in any hazardous, corrosive, or outdoor location. Transmission lines are standard copper tubing, no electrical hazard, no costly capillary to run.

Write for Bulletin 13-17. It explains fully why the Foxboro M/12A Temperature Transmitter gives better performance with lower installation and maintenance cost. **The Foxboro Company, 963 Neponset Ave., Foxboro, Mass., U.S.A.**

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Portrait by Fabian Bachrach

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MECHANICAL ENGINEERING

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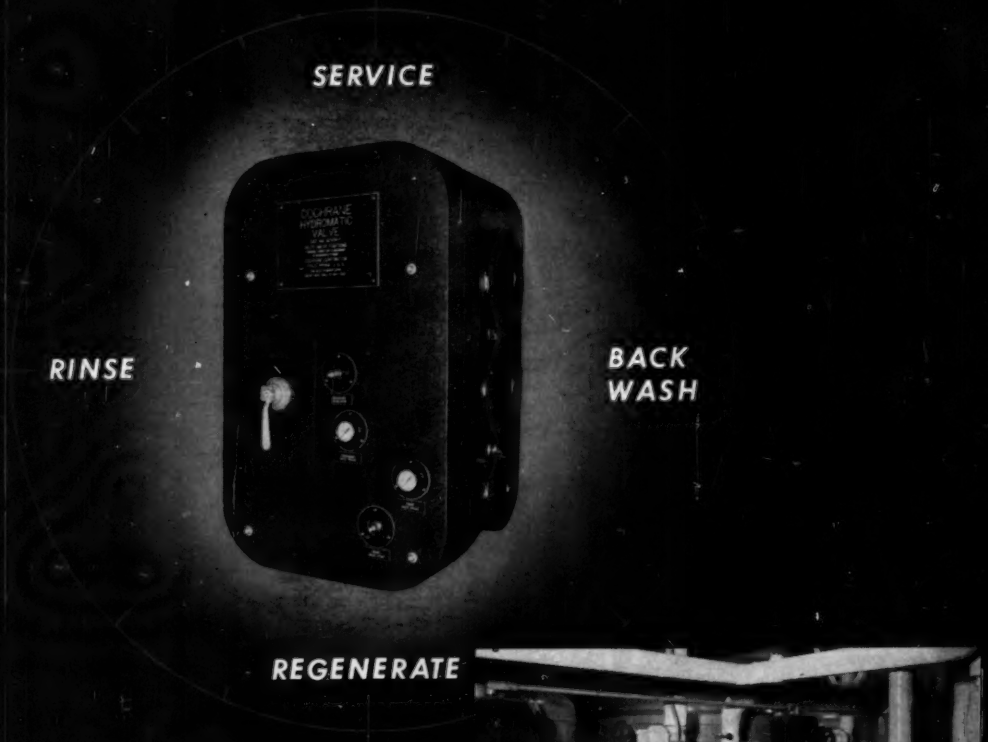
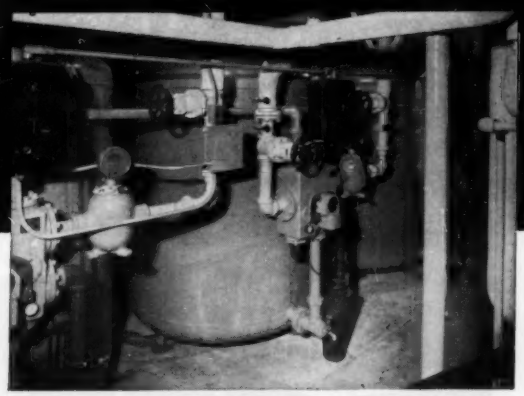


SIMPLIFIED CONTROL



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Here is a valve so simple to operate that no knowledge of softening equipment or of the ion-exchange process is required!

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AD. 3.10

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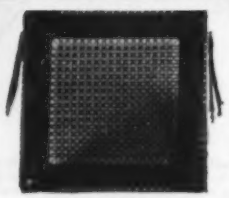
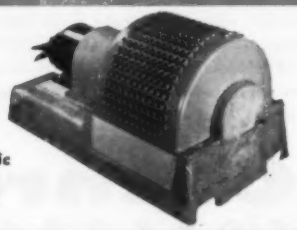
Future Philadelphia Plant



Magnetic Core Storage

Magnetic Tape Units



Magnetic Drum Storage

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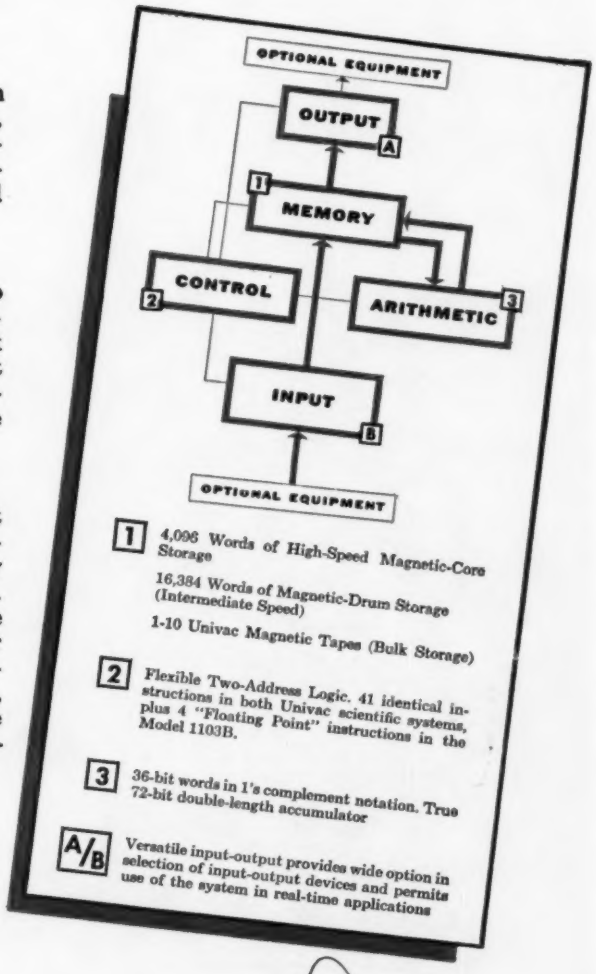
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CONTROL
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OPTIONAL EQUIPMENT
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1-10 Univac Magnetic Tapes (Bulk Storage)
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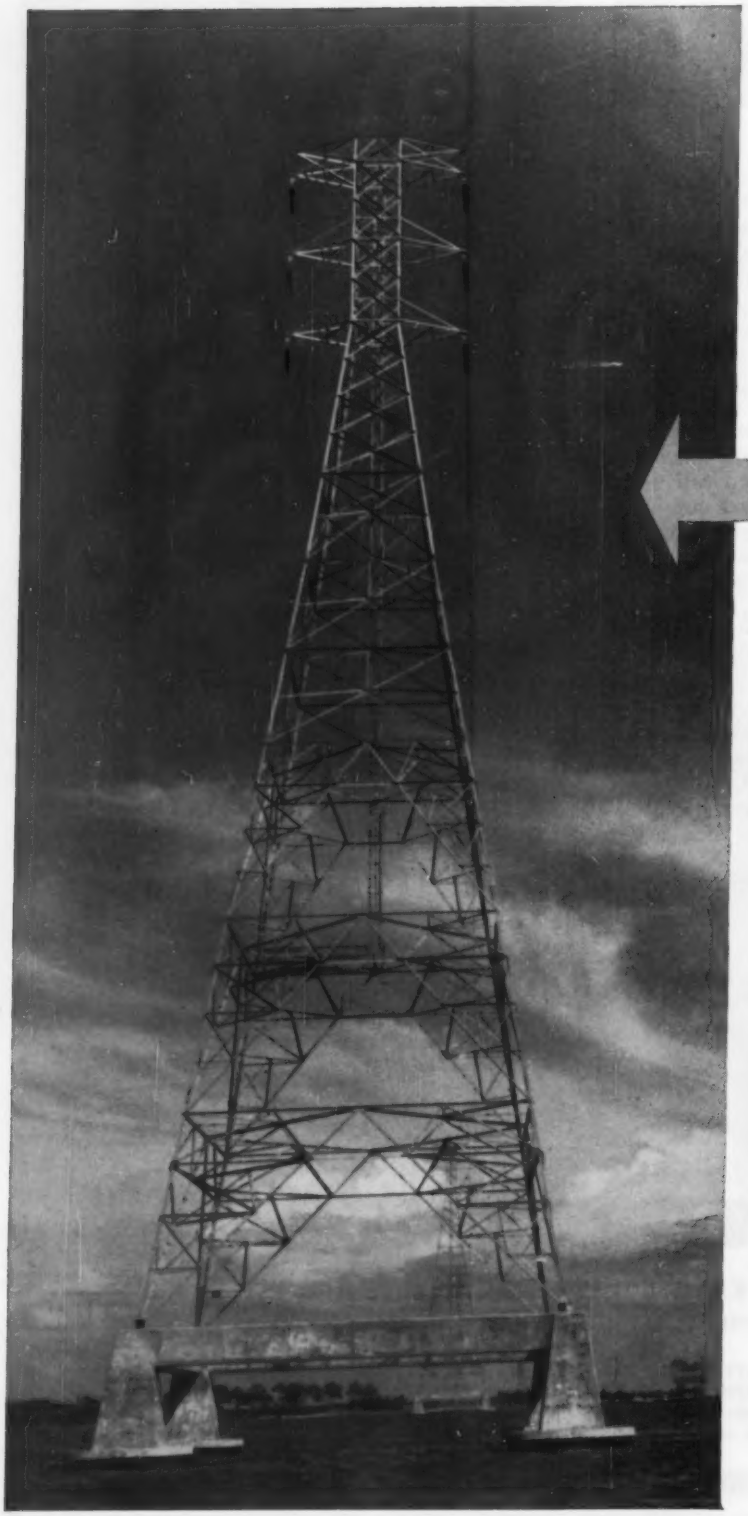
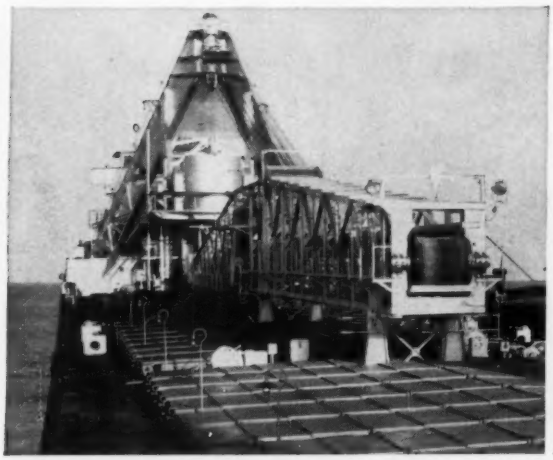


ERECTION COSTS REDUCED $7,200 by using USS MAN-TEN Steel rather than carbon steel in the legs of four 198 ft. transmission towers that carry power lines across Old Tampa Bay, Florida. Six tons of weight saved by MAN-TEN Steel in the East Bank tower saved $1,200 in erection cost. The 6½ tons saved in each of the three towers erected in the Bay saved $6,000 more. The total of 26 tons of steel saved by using MAN-TEN Steel also reduced the cost of the material used in the towers, even though MAN-TEN Steel costs a little more per lb. (Towers designed and fabricated by American Bridge Division of United States Steel for Florida Power Corporation, St. Petersburg, Fla. Erected by Southeastern Utilities Service Co., Miami, Fla.)

THE SUPERIOR STAMINA and corrosion resistance of USS COR-TEN Steel save power by saving weight, insure minimum maintenance and longer service life in this full-length "dome" lounge car built for the Milwaukee Road by Pullman-Standard Car Manufacturing Company, Chicago, Ill. More than 6,000 modern passenger cars and 190,000 freight cars of all types have been built to date with USS COR-TEN Steel.

with USS High Strength Steels



USED IN THE LOADING BOOM and supporting "A" frame of this self-unloading cargo vessel which can discharge 4,500 tons of limestone per hour, USS TRI-TEN "E" Steel not only materially increases the strength and durability of the structure but saves more than 18,000 lbs. of weight. 50,000 lbs. of TRI-TEN "E" Steel in plate and structural form were used in this application. (Designed by Robins Engineers, Division of Hewitt-Robins, Incorporated, for Manitowoc Shipbuilding, Incorporated.)

WEIGHT WAS REDUCED 10% yet strength-to-weight ratio was increased over former construction by using USS MAN-TEN Steel in the arch boom, "A" frame and tongue of this heavy-duty logging unit. The increased strength provided by MAN-TEN Steel makes it possible to handle log loads of maximum size—the reduced weight ensures greater mobility and maneuverability. Result: more footage, handled faster. (Designed and built by Hyster Company, Portland, Ore.)

IN USS HIGH STRENGTH STEELS, design engineers have at their command three service-tested steels that will permit them to materially increase the efficiency and economy of machinery, equipment and structures at little or no increase in first cost . . . and frequently, at a saving.

All three of these famous "steels that do more" – USS COR-TEN, USS MAN-TEN and USS TRI-TEN – have a 50% higher yield point than ordinary carbon steel. All have better corrosion resistance and offer greater resistance to wear, fatigue and impact. Each, however, has specific superior properties that should be considered in determining its selection.

USS COR-TEN Steel, for example, is distinguished by its superior resistance to atmospheric corrosion—4 to 6 times that of carbon steel. USS MAN-TEN Steel is intended for weight reduction by means of greater strength in moderate forming applications, with enhanced resistance to abrasion and atmospheric corrosion. USS TRI-TEN Steel's outstanding characteristics are excellent weldability and resistance to shock at low temperatures.

Used singly or in combination, these steels can advantageously replace carbon steel to increase the strength and durability of vital parts *without* increasing their weight. Or when the use of thinner sections is feasible they can (1) reduce equipment weight without reducing its strength, or (2) increase the size and capacity of equipment without increasing total weight or the power required to move it.

You will find our 174-page *"Design Manual for High Strength Steels"* extremely useful in applying the benefits of these steels to your product. Send for free copy—simply write on your company letterhead to United States Steel Corporation, Room 5253, 525 William Penn Place, Pittsburgh 30, Pa.

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UNITED STATES STEEL

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This model of a supersonic airplane design was dropped at extreme altitude from a B-47 Stratojet. Telemetered data revealed the characteristics of its supersonic flight to destruction at the earth's surface. This is just one example of Boeing-Wichita's continuing development of advanced aircraft and associated systems.

At Wichita research and development programs are expanding rapidly. Laboratory space has been quadrupled and many other new engineering facilities have been added to keep pace with increasing emphasis on technical development. At both of the company's plants, Seattle and Wichita, the increased scope and magnitude of this development effort is creating additional and excellent career opportunities for mechanical engineers.

This means that there is a real challenge for you in one of Boeing's design, research or production engineering programs. Among the interesting assignments for mechanical engineers at Boeing are controls and mechanisms design, structures and stress analysis, propulsion and thermodynamics analysis, heating and ventilating. Working in tight-knit teams provides plenty of room for self-expression and recognition.

Boeing engineers are working now on future airplanes and missiles that will maintain the standard of technical superiority established by the B-47 medium bomber, the B-52 intercontinental bomber, the BOMARC IM-99 pilotless interceptor, the 707 jet transport and the KC-135 jet tanker-transport.

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NOTE: Papers for the above two awards must be submitted before thirty days after completion of undergraduate work.

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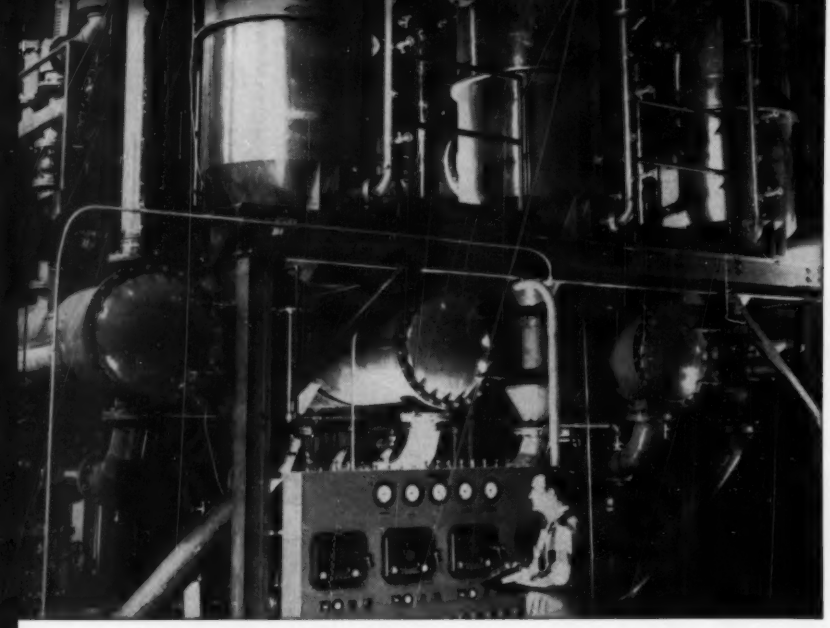
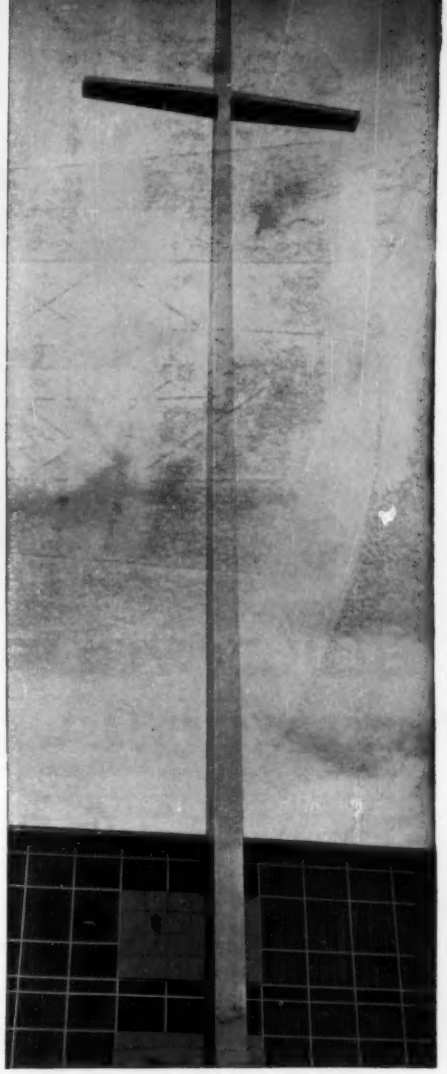


FOR CORROSION RESISTANCE. The Marathon Corporation developed a method of producing lignosulfonates from paper mill sulfite liquor, but it was impractical until Stainless Steel became available in the 1930's. The plant now produces 75 million pounds a year, and 50% of the equipment is Stainless Steel.

NOTHING *can equal* *Stainless Steel*



FOR ENDURING BEAUTY. This great religious symbol is erected on the grounds of St. Patrick's Academy, Chicago, Ill. The Stainless Steel skin furnishes a gleaming, permanent inspiration to all viewers.

• No other design material can match Stainless Steel in its *combination* of desirable properties: corrosion resistance, strength and hardness, beauty, cleanability and easy fabrication. When buying Stainless, remember that United States Steel offers the widest range of types, finishes and sizes available in the United States.

FOR WET, ABRASIVE SERVICE. Here's a Stainless Steel shaker screen in a coal plant. Management says, "Ordinary screens would only last about two weeks, but we can expect three *years* of service from these Stainless Steel screens . . ."

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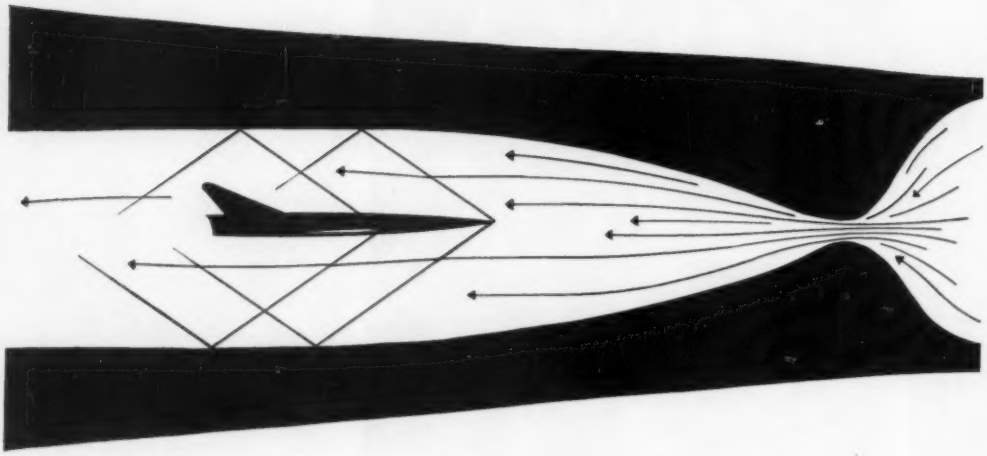

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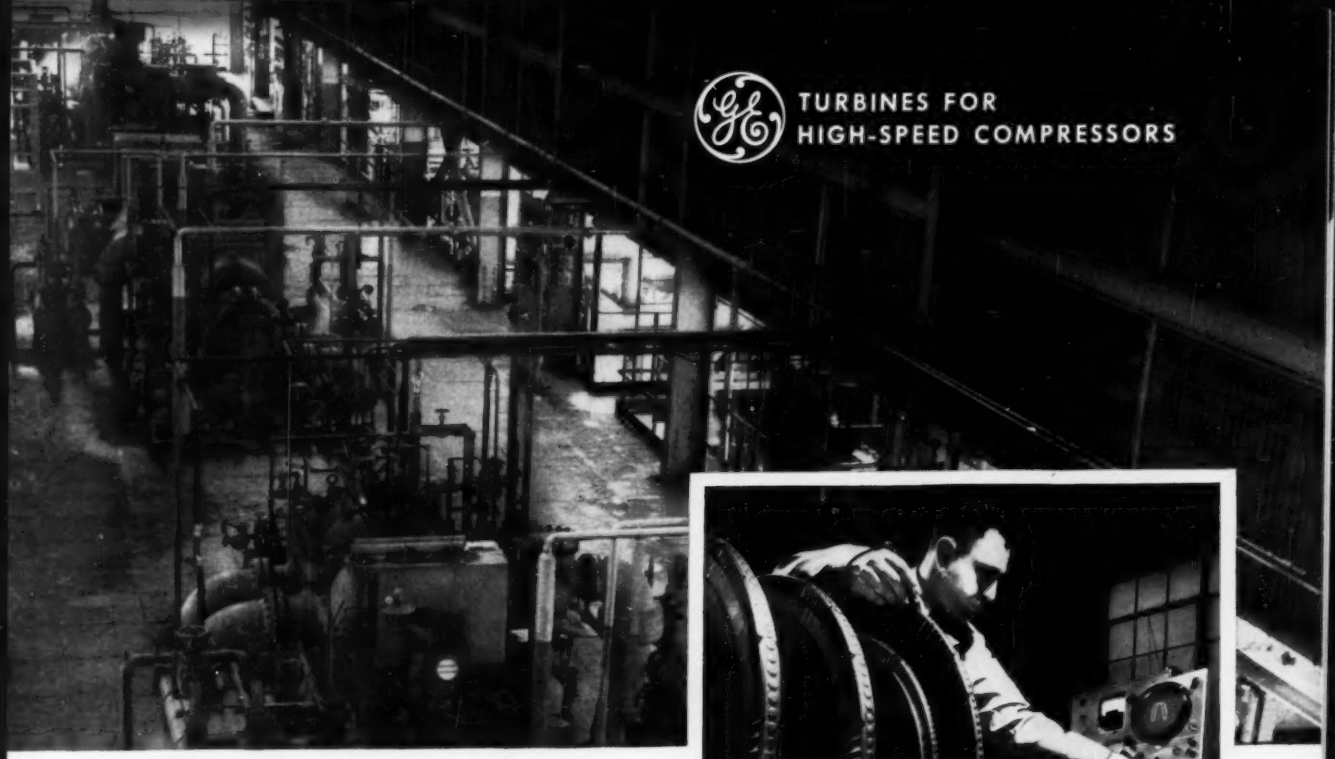

Six General Electric high-speed turbines operate on 'round-the-clock compressor service at Gulf refinery in Port Arthur, Texas.

For greater bucket reliability, G-E engineer locates "quiet zone" of resonant vibration in buckets to assure that steam-impact frequencies and natural bucket frequencies do not coincide.

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IN PROCESS INDUSTRIES, where outages can cost upwards of $20,000 a day, turbine reliability is a major consideration when specifying compressor and blower drives. General Electric mechanical-drive turbines have built-in reliability features that can assure minimum down-time and greater profits for your operation:

HEAVY-DUTY ROTORS are machined from a single forging to withstand years of continuous high-speed operation. The rotor is completely balanced without buckets, then balanced again as each wheel is bucketed.

EXTERNAL DOVETAIL BUCKETS are attached to wheel rims with machine fit. External construction assures proper force distribution at high speed, gives better rotor protection from moisture erosion.

LARGE PRESSURE PAD BEARINGS furnished on all G-E high-speed turbines minimize shaft vibration. Generous bearing surfaces assure low unit loading for ample lubrication and minimum wear during turbine start-up.

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CARBON PACKING used in addition to metallic labyrinth packing assures efficient steam sealing on G-E high-speed turbines. Carbon rings in external packing boxes are non-sizing, have high mechanical strength in the small sizes used.

POSITION RESTORED GOVERNING SYSTEM is designed for close accurate governing in response to load requirement and the slightest variations in steam conditions. Governor will operate with any recycle controlling system.

These are but a few of the important design features that account for consistent reliability of General Electric high-speed mechanical-drive turbines. For further information, contact your nearest G-E Apparatus Sales Office, or write for new bulletin GEA-6232, General Electric Company, Section 241-5, Fitchburg, Mass.

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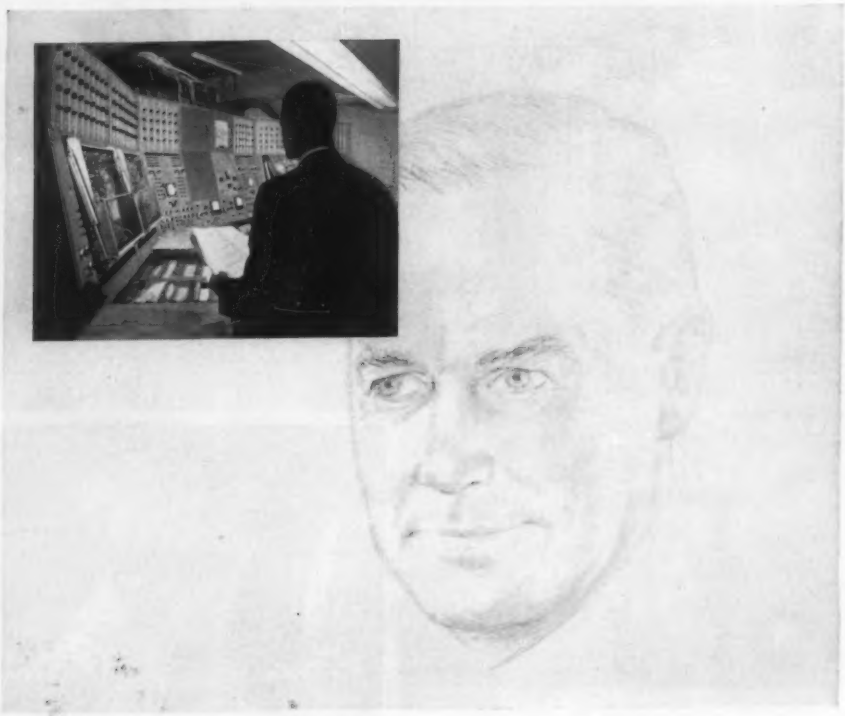

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"I was pickin' pansies in Belleau Wood"

THEY WERE only a handful of dirty, haggard Marines. Paralyzed, they hugged the earth outside Lucy le Bocage as murderous German fire poured at them. And then they heard their little, middle-aged sergeant:

"Come on, you ---- -- -------!
Do you want to live forever?"

That yell, and the charge that followed, made Sergeant Dan Daly famous. But he wanted no glory. He already had *two* Medals of Honor, one earned in Peking, the other in the jungles of Haiti.

And when reporters asked about his World War I decorations, he said: "I was out in Belleau Wood pickin' pansies for my girl one day. And the officers said: 'Let's give the poor guy a medal.' Well, sir, they give me the DSC . . ."

No hero to himself, Dan Daly was a fearless and expert professional soldier—one of a breed some folks don't expect of a wealthy, peaceful land like America. Yet America's ability to produce men like Daly is a more important clue to her strength than all the gold at Fort Knox.

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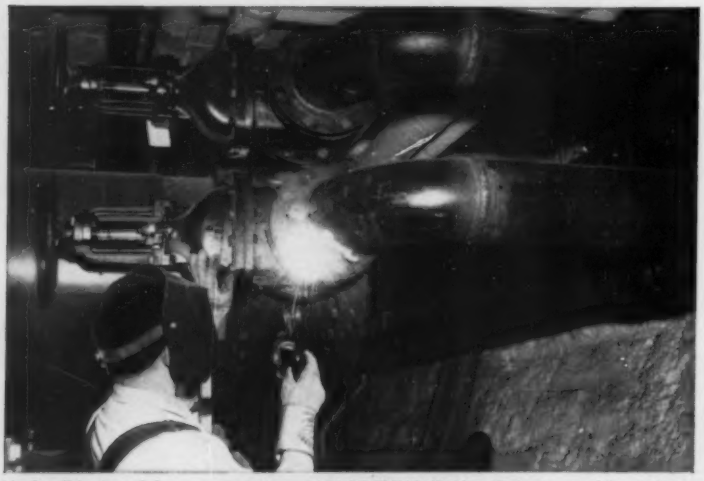
helps you apply wrought iron fittings on jobs like these...



Air Conditioning piping . . . wrought iron and TUBE-TURN* Welding Fittings are used for condenser water lines shown here, part of new air conditioning installation at State Capitol Building, Harrisburg, Pennsylvania. Contractors: Riggs Distler & Co., Inc.

Down Spouts on Abbey Avenue Bridge, Cleveland. Made of 10" wrought iron pipe, with 45° TUBE-TURN Wrought Iron Elbows. Contractor: Gorman-Lavelle Co., Cleveland.

Hospital piping . . . wrought iron 5" cold water, 2½" high-pressure condensate returns and 4" pump discharge . . . at City Hospital, Cleveland. TUBE-TURN Wrought Iron Fittings used throughout.

Radiant Heating. Many engineers prefer wrought iron piping for these systems (and snow-removal systems). Shown here: welding in bank of coils to hot water line with TUBE-TURN Welding Tee at Capitol Annex Building, Frankfort, Kentucky. Contractor: B. A. Walterman Co., Cincinnati.

All-around Service. Your nearby Tube Turns' distributor will see that your needs in fittings (of all materials, types and sizes) are met promptly. He will also see that you get Tube Turns' engineering service on your piping applications.

WROUGHT IRON FITTINGS AVAILABLE FROM YOUR NEARBY TUBE TURNS' DISTRIBUTOR

90° ELBOWS

45° ELBOWS

180° RETURNS

TEES

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*"TUBE-TURN" and "tt" Reg. U.S. Pat. Off.

TUBE TURNS

A DIVISION OF NATIONAL CYLINDER GAS COMPANY

LOUISVILLE 1, KENTUCKY

DISTRICT OFFICES: New York • Philadelphia • Pittsburgh Cleveland • Detroit • Chicago • Denver • Los Angeles San Francisco • Seattle • Atlanta • Tulsa • Houston Kansas City • Dallas • Midland, Texas

APPLICATION DATA

for use of TUBE-TURN Wrought Iron Welding Fittings

TUBE TURNS, Dept. F-1

224 East Broadway, Louisville 1, Kentucky

Please send Bulletin TT-787 on Wrought Iron Fittings.

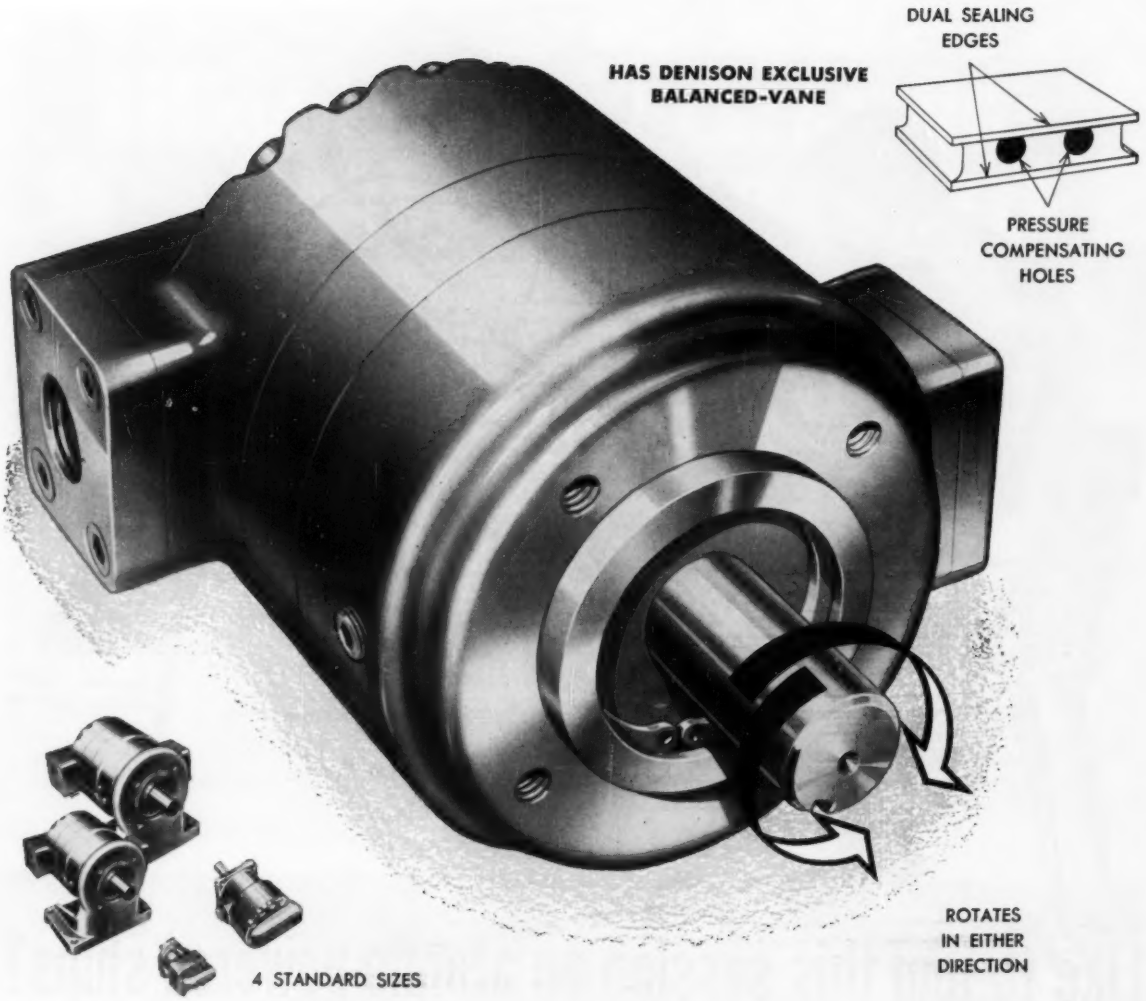
Company Name _____

Company Address _____

City _____ *Zone* _____ *State* _____

Your Name _____

Your Position _____



for continuous 2000 psi service...

Vane type Denison hydraulic single stage, Pump/Motor

IT'S A PUMP—high delivery in a small, compact package . . . a continuous 2000 psi pump.

IT'S A MOTOR—high stalled torque up to 257 pound-inches per 100 psi. Takes high shock pressures without danger.

EXCLUSIVE—Denison *Radially Balanced* Vane; *Cuts wear* between cam ring and vane; *Increases efficiency* with dual sealing edges; *Reduces pulsation* by radial pumping action of vanes.

SIMPLIFIES INVENTORY

No need to stock separate pumps and motors. Runs as a pump or motor without alterations. Range of capacities in each size through interchangeable cam rings.

EITHER DIRECTION—Operates efficiently as a pump or motor without change in piping. Minimum internal friction in either direction because of greatly reduced contact pressure between vanes and cam ring.

STANDARD SIZES—as a pump, Range of delivery 2.5 to 77 gallons per minute at 2000 psi.
As a motor, Horsepower output 1 to 103 hp at 2000 psi.

MORE INFORMATION—Send for Bulletin P-5-A giving complete specifications. Write . . .

THE DENISON ENGINEERING COMPANY
1174 Dublin Road • Columbus 16, Ohio
A Subsidiary of American Brake Shoe Co.

DENISON Hydr OIL ics

HYDRAULIC PRESSES • PUMPS • MOTORS • CONTROLS

Like to join this session on atomic-powered ships?

This is a working session of some of the country's best scientific and engineering minds. Their assignment: develop, design and construct atomic power plants for a fleet of ships. Where are they? At Bettis Plant, Pittsburgh, operated by Westinghouse for the AEC. This is the largest design and engineering center for atomic power plants in the country. Here the power plants for an atomic fleet are actually being designed and built.

You can join them if you are a competent physicist, mathematician, metallurgist, mechanical or electrical engineer. The work is fascinating—anything but routine—because so many of the important things being done at Bettis are being done for the first time.

Activity at Bettis Plant is expanding because more power reactors are being built here than at any other place.

Atomic experience is *not* required. Write for a descriptive brochure describing opportunities in your field. Be sure to indicate your specific interests. Mr. A. M. Johnston, Westinghouse Bettis Plant, P. O. Box 1468, Dept. A-14, Pittsburgh 30, Pa.

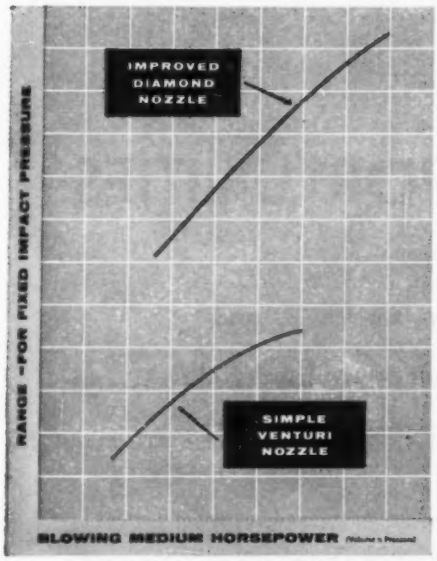
Westinghouse

BETTIS PLANT

First in atomic power

GETTING BACK TO FUNDAMENTALS:

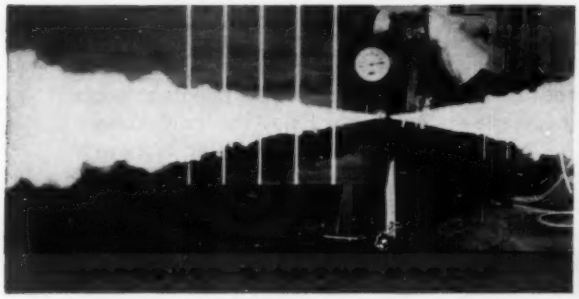
Efficient BOILER CLEANING Starts at the BLOWER NOZZLE

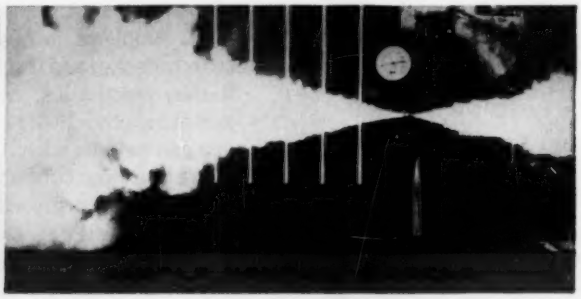


Photograph of section through Diamond "Type A" Nozzle.

The blower nozzle has the job of converting steam or air pressure into velocity which, in turn, produces impact pressure at the surface to be cleaned. Effective cleaning depends on this impact pressure. A well-designed nozzle will convert much more efficiently . . . doing a better cleaning job with less steam or air.

During the past several years Diamond has conducted intensive research into nozzle design to find the ultimate in efficiency. (More than 50 designs were tested.) It was soon found that nozzle design responds to perfection of detail. Among the details studied were: (1) divergence angle of nozzle, (2) inlet radius as a function of throat diameter, (3) length-diameter ratio of nozzle, (4) area ratio of lance to nozzle throat, and (5) nozzle approach conditions. A product of this research is our new "Type A" Nozzle for Model IK Blowers. The curves at the left show how much more efficient it is than the simple venturi nozzle. The result is improved cleaning at substantially lower energy cost.





The two photographs above show the Improved Diamond Nozzle and the simple venturi nozzle under identical test conditions. These tests proved that the effective range of the new Diamond nozzle is substantially greater. Also that at the same range, the impact pressure of the Improved Diamond Nozzle is much higher than for the simple nozzle. For equal cleaning ability, the higher efficiency of the new Diamond nozzle requires a much lower blowing medium pressure.

DIAMOND POWER SPECIALTY CORP. • Lancaster, Ohio

Diamond Specialty Limited • Windsor, Ontario

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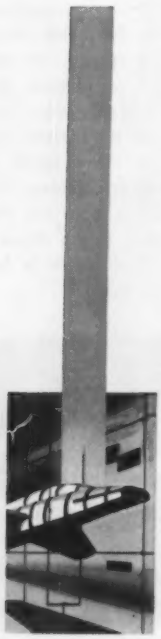
SUPERSONIC AIRCRAFT

CREATE MANY

ENGINEERING OPPORTUNITIES



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Opportunities in our other engineering departments offer you a wide scope for your talents at North American. Enjoy the individualism and team spirit we offer. Work with engineers who respect your opinions and professional status. Check over our list of openings below and get in touch with us. It will be well worth your inquiry.

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Flutter Aeroelastic and flutter analysis now being conducted on current and advanced designs of supersonic airplanes. Experience and capability in independent flutter analysis projects required. Advanced degree desired, but not necessary for man with adequate background.

Electronics Analog and Digital computer experience required. Formulate and solve aeroelastic problems. B.S. degree desired.

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NORTH AMERICAN HAS BUILT MORE AIRPLANES THAN ANY OTHER COMPANY IN THE WORLD

Pumping Progress Report

FOR MECHANICAL ENGINEERS

An advertisement prepared by the Aldrich Pump Co., Member of Hydraulic Institute, U.S.A.

PUMP INSPECTION, MAINTENANCE AND REPAIR are jobs too frequently ignored in the design of production pumps. This has been verified by a survey of more than 15,000 pump installations. Speed and economy of maintenance was frequently quoted as a major factor in pump selection.

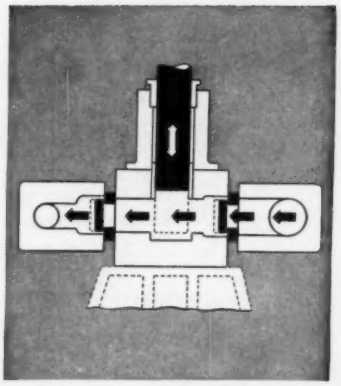
SECTIONALIZED FLUID-ENDS offer one of the best ways to guarantee both speed and economy in pump maintenance. As originated by ALDRICH Pump Co. Engineers, the Sectionalized Fluid-End comprises four main assemblies — the working barrel, suction manifold, discharge manifold and stuffing box.

SPEED IN MAINTENANCE is assured because of ease of accessibility of all wearing parts. Manifolds can be slid back on studs and valves removed as complete units. Split collar and flange connection of plunger to yoke permits easy removal of plunger.

ECONOMY OF MAINTENANCE results from speed in maintenance. Perhaps even more important is the simple fact that it is cheaper to replace a single section than a complete fluid-end. Another important economy is parts interchangeability. Among 3-, 5-, 7- and 9-plunger units of any series, wearing parts are interchangeable. Where a combination of multiplex pumps is required, this reduces spare parts stocks.

THE ALDRICH PUMP COMPANY is the originator of the DIRECT FLOW principle — a design innovation that utilizes the sectionalized fluid-end principle. Aldrich Engineers have become known as the people to take your tough pumping problems to. We have never turned down a challenge.

FURTHER INFORMATION can be had direct from the company. Tell us your problem and we'll send you Data Sheets describing the size pump we recommend to solve your problem. Address your request to: The Aldrich Pump Company, 29 Pine Street, Allentown, Pa.



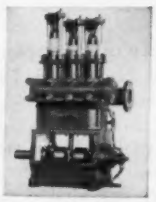
Aldrich Direct Flow Fluid-End Design

...for your tough pumping problems specify ALDRICH

The Direct Flow principle, an Aldrich design innovation, is a major forward step toward the solution of tough pumping problems of all kinds. Not only does it eliminate two right-angle turns in the fluid-end, but in addition makes possible complete Fluid-End Sectionalization. This is another Aldrich design innovation which permits economies of maintenance and repair offered by no other type pump.

CHECK THESE ADVANTAGES OF SECTIONALIZED FLUID-ENDS:

Less expensive parts replacement
Ease of inspection and maintenance
Interchangeable wearing parts
No special equipment for valve removal
Easily accessible stuffing boxes



Write today for Data Sheets describing the Direct Flow Pump Series.

THE ALDRICH PUMP COMPANY

Originators of the Direct Flow Pump
29 PINE STREET
ALLENTOWN, PA.
Representatives in principal cities

TO THE MEMBERS OF———

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

Members of the ASME are invited to name any number of engineers as candidates for membership. Engineering acquaintances should be qualified by both fundamental training and experience for one of the technical grades. Those who do not have an engineering degree may show the equivalent thereof through actual practice. Executives of attainment in science or industry may associate with the Society as Affiliates.

THE American Society of Mechanical Engineers promotes Mechanical Engineering and the allied arts and sciences, encourages original research, fosters engineering education, advances the standards of engineering, promotes the intercourse of engineers among themselves and with allied technologists; separately and in cooperation with other engineering and technical societies, and works to broaden the usefulness of the engineering profession.

As a post graduate school of engineering, the Society brings engineers into contact with each other, with leaders of thought and with new developments; it fosters the interchange of ideas, develops professional fellowships, and encourages a high standard of professional conduct—all with the purpose of advancing civilization and increasing the well-being of mankind.

C. E. Davies, Secretary
The American Society of Mechanical Engineers
29 West 39th Street, New York 18, N. Y.

Date.....

Please send an application and information regarding ASME to the following:

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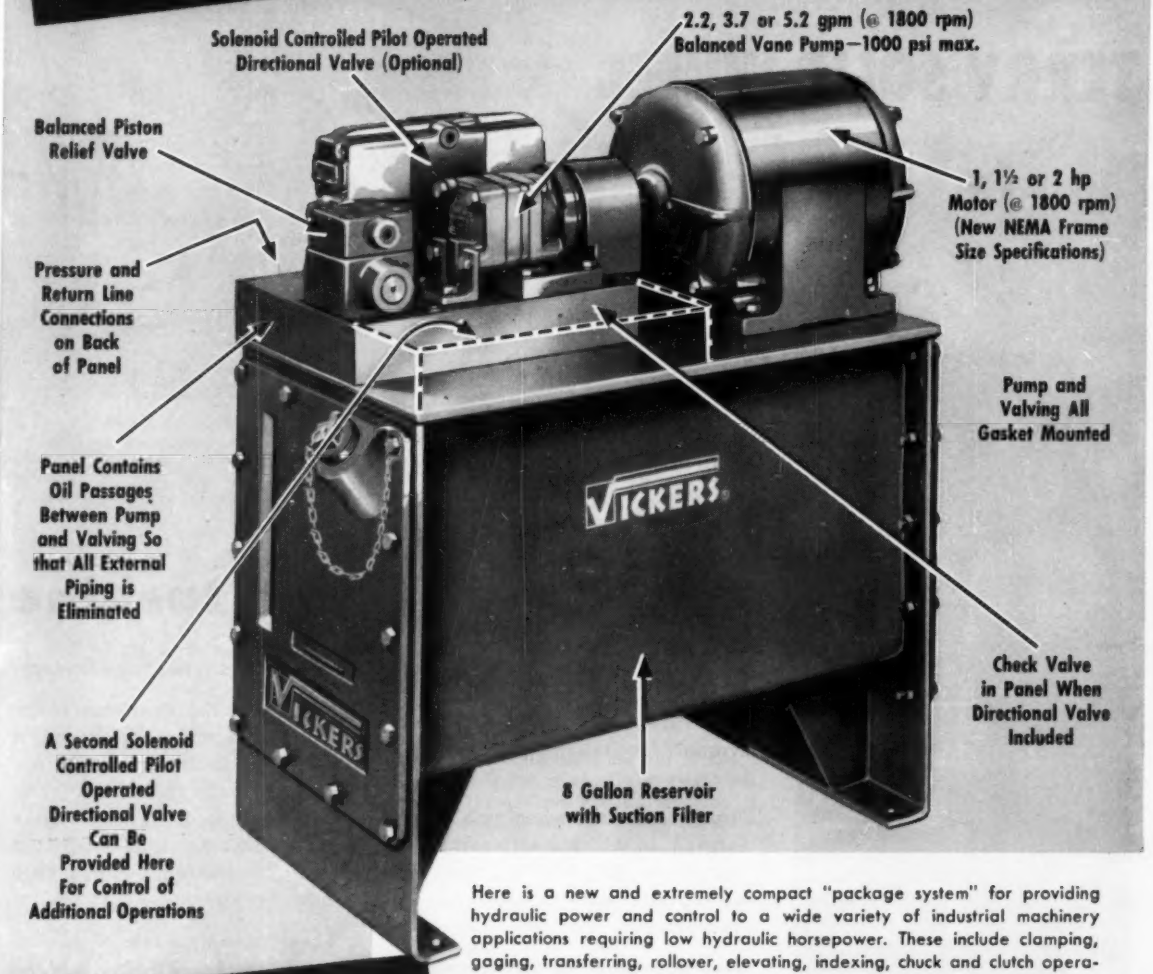
ME-3-56

A NEW IDEA . . . in hydraulic power and control systems


Solenoid Controlled Pilot Operated Directional Valve (Optional)
2.2, 3.7 or 5.2 gpm (@ 1800 rpm) Balanced Vane Pump—1000 psi max.
Balanced Piston Relief Valve
1, 1½ or 2 hp Motor (@ 1800 rpm) (New NEMA Frame Size Specifications)
Pressure and Return Line Connections on Back of Panel
Pump and Valving All Gasket Mounted
Panel Contains Oil Passages Between Pump and Valving So that All External Piping is Eliminated
VICKERS
Check Valve in Panel When Directional Valve Included
A Second Solenoid Controlled Pilot Operated Directional Valve Can Be Provided Here For Control of Additional Operations
8 Gallon Reservoir with Suction Filter

Here is a new and extremely compact "package system" for providing hydraulic power and control to a wide variety of industrial machinery applications requiring low hydraulic horsepower. These include clamping, gaging, transferring, rollover, elevating, indexing, chuck and clutch operations, etc.

Note the many features indicated on the photograph above. The result is improved and simplified hydraulic design . . . also reduced installation and maintenance costs. This "package system" has great flexibility . . . is available in a wide variety of combinations of standard components assembled to suit individual requirements. Pretested and ready for immediate operation, it has also the advantage of undivided Vickers responsibility. For further information, ask for installation drawings 178706-8.

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Series T8 HYDRAULIC PIPELESS POWER PACKAGE*

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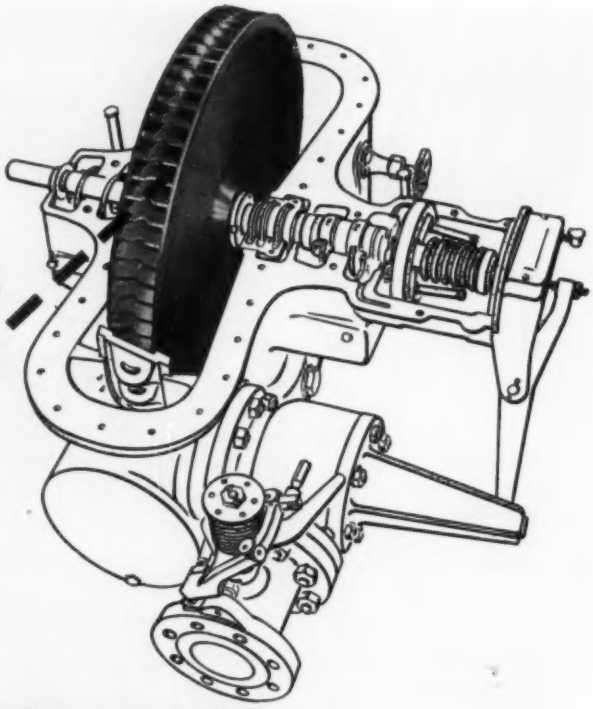
IN CANADA: Vickers-Sperry of Canada, Ltd., Toronto

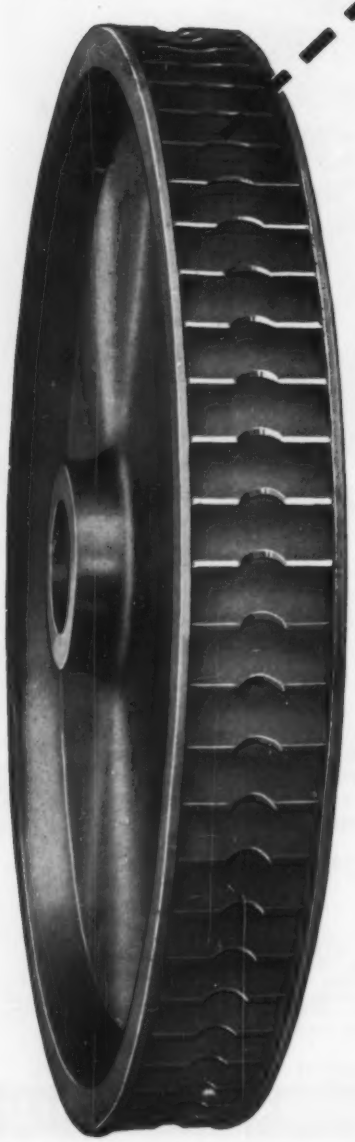
7311

*These "package systems" supplement the Vickers line of standard hydraulic power units.

ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

TERRY SOLID WHEEL





..."trade mark" of a trouble-free turbine

This is the rotor of a Terry solid-wheel turbine. There are a number of reasons why it has become a symbol for reliable, trouble-free operation.

First, because the wheel is a single forging, in which a series of semi-circular buckets is milled, there are no separate parts to become loose or work out.

Second, because the power-producing action of the steam takes place on the curved surfaces at the back of the buckets, blade wear is of little consequence. Wear does not materially affect horsepower or efficiency.

Third, because the steam enters the buckets in a direction at right angles to the shaft, there is no need for close axial blade clearances. The blades cannot foul. There is a one inch clearance on either side of the wheel. In addition, the blades are double rim protected.

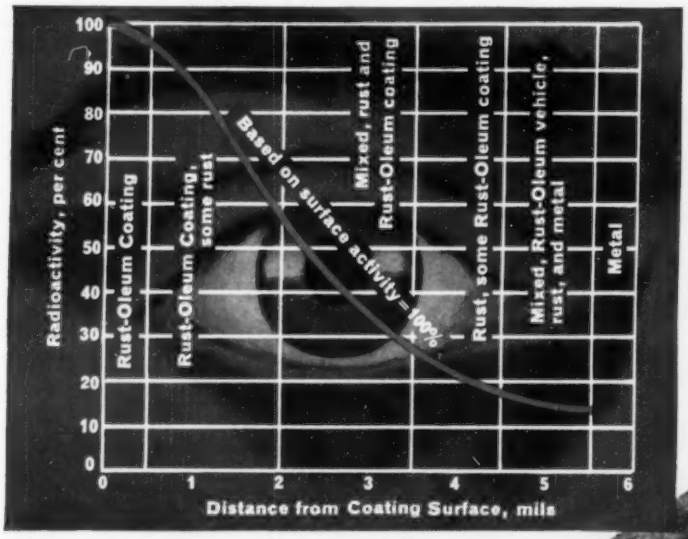
These are only a few of the reasons why the Terry solid wheel has become a "Trade Mark" for trouble-free turbine performance. For complete details, send for a copy of bulletin S-116. No cost or obligation.

THE TERRY STEAM TURBINE CO.
TERRY SQUARE, HARTFORD 1, CONN.

TERRY

TT-1197

See Rust-Oleum *penetrate rust* to bare metal through the "Eyes" of Radioactivity!



Curved line illustrates Rust-Oleum penetration through rust at each mil level as recorded by Geiger Counter.

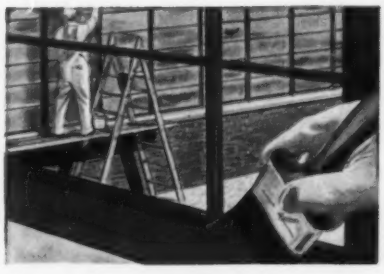
Rust-Oleum dries to a firm, decorative coating that resists salt water, sun, fumes, heat, humidity, and weathering.

Geiger Counter traces Rust-Oleum penetration to bare metal! In nearly three years of radioactive research, Rust-Oleum's *specially-processed* fish oil vehicle was radio-activated and formulated into Rust-Oleum 769 Damp-Proof Red Primer – then applied to rusted test panels. Rust-Oleum's specially-processed fish oil vehicle was then traced through the rust to bare metal by Geiger Counter.

This penetration means rust-stopping power, because the fish oil vehicle works its way into the tiny pits in the metal where it drives out air and moisture that cause rust. Important savings are yours, because Rust-Oleum can be applied directly over sound rusted surfaces – usually eliminating costly surface preparations. Attach coupon to your business letterhead for your copy of the thirty-page report entitled, "The Development of a Method To Determine The Degree of Penetration of a Rust-Oleum Fish-Oil-Based Coating Into Rust On Steel Specimens," prepared by Battelle Memorial Institute technologists. Prompt delivery of Rust-Oleum is assured from your nearby industrial distributor.

There is only one Rust-Oleum. It is distinctive as your own fingerprint.

RUST-OLEUM®



STOPS RUST!

Rust-Oleum is available in practically all colors, including aluminum and white. See our complete catalog in Sweets, or write for information.

ATTACH TO YOUR LETTERHEAD—MAIL TODAY!

Rust-Oleum Corporation
2901 Oakton Street
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- ☐ Complete literature with color charts.
- ☐ Thirty-page report on Rust-Oleum penetration.
- ☐ Nearest source of supply.

ARE YOU SURE YOU HAVE FIRE PROTECTION?

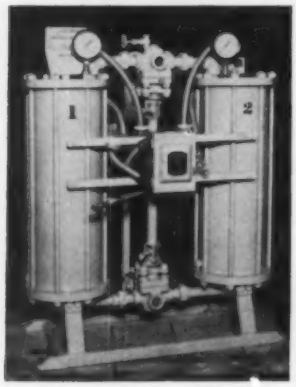
That sprinkler system may be frozen solid, even though it's only carrying compressed air

This happened five years ago—

Fire inspectors in St. Louis tested the sprinkler system in a cold storage plant and found it useless. Moisture in the compressed air that fills the piping *to prevent freezeups* had condensed and frozen at points where supply lines enter the cold rooms. Water couldn't get past this ice.

Booth Cold Storage Company, also of St. Louis, became alarmed at this report and tested their sprinkler system. The same condition existed—frozen supply lines and no sprinkler protection. So they took immediate steps to clear their lines and made certain this never happens again.

Working backwards from the cold rooms to the power plant, Propylene Glycol was pumped through one supply line after another. It took a full year to complete the task, but every pipe was freed of ice and rust.



This little Lectrodryer safeguards the Booth Cold Storage Company plant against freeze-ups in their fire protection system.

Now a Lectrodryer* and Lectrofilter* DRY and CLEAN the air before it enters the sprinkler system. Dried to a dewpoint of -40°, there'll be no condensation to cause trouble, since the lowest coldroom temperature is -20°. The book, ***Because Moisture Isn't Pink,*** tells you more about Lectrodryers. Pittsburgh Lectrodryer Corporation, 335 32nd Street, Pittsburgh 30, Pennsylvania.

In England: Birlec, Limited, Tyburn Road, Erdington, Birmingham.
In France: Stein et Roubaix, 24 Rue Erlanger, Paris XVI.
In Belgium: S. A. Belge Stein et Roubaix, 320 Rue du Moulin, Bressoux-Liege

LECTRODRYERS DRY WITH ACTIVATED ALUMINAS

LECTRODRYER

* REGISTERED TRADEMARK U. S. PAT. OFF.

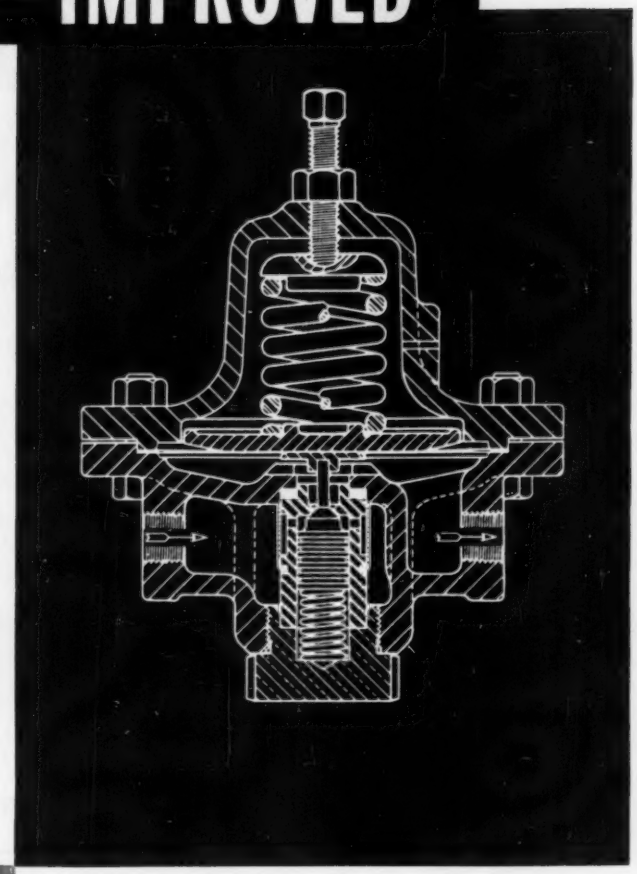
REDESIGNED—IMPROVED

THE CASH STANDARD TYPE D

Pressure Reducing and Regulating Valve

NOW . . . half the number of bolts saves maintenance time and . . . gasket seal at diaphragm flange provides easier pressure range conversion.

BUT . . . performance-wise it is still the same dependable valve that CASH STANDARD has offered for over 35 years to provide precise automatic control of most liquids, steam and gases.



- Internal working unit still interchangeable with other models
- Interior easily accessible for quick cleaning or replacement
- Simple construction—minimum of parts
- Built-in strainer
- Available in iron, bronze, steel or stainless steel body, and bronze, stainless steel, nitralloy or monel trim
- Screwed ends, sizes ¼" to 2"

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CASH CS STANDARD

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PRESSURE, HYDRAULIC, TEMPERATURE, PROCESS AND COMBUSTION CONTROLS

MECHANICAL CATALOG

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Surveys show that you are *four times more likely* to get an order when the prospect has *read your literature before* he sees your salesman.

When you insert your literature and specifications in the Product Data Section of MECHANICAL CATALOG, you get these advantages in the Directory:

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2. Your Catalog page numbers are listed.
3. Your name—with others in the Product Data Section—heads each Directory classification in which it appears.

The mechanical engineer takes these steps to buying. Will they lead him to you . . . or to a competitor?

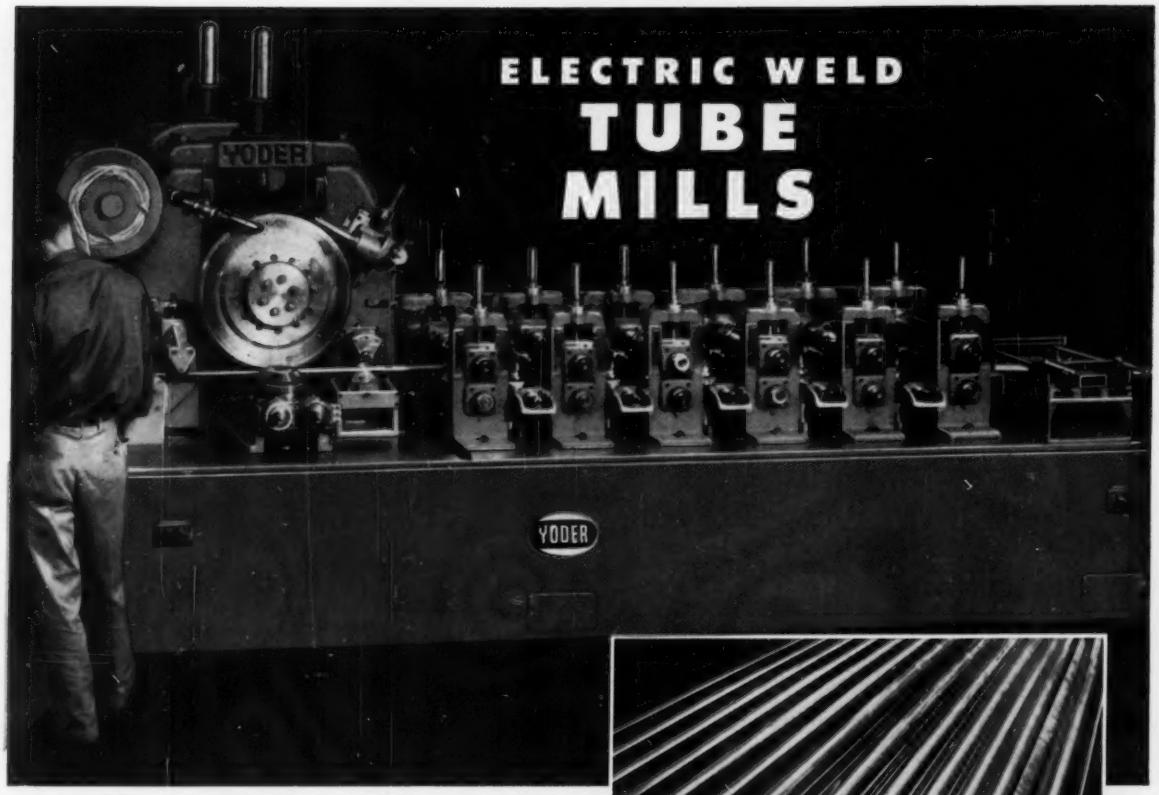
1. Looks in the Directory for manufacturers of the product he needs.
2. Refers to Catalog page numbers listed for product specifications.
3. Calls firms whose product data come closest to supplying his needs,

or

4. If information is sufficient, writes his specifications directly from sales data in Catalog.

Either way—You're already *inside* his plant *when he needs you* . . . if your product data is in MECHANICAL CATALOG. For full information and rates on the Product Data Section of 1957 Mechanical Catalog, write to S. A. Tucker, Publications Business Manager, The American Society of Mechanical Engineers, 29 W. 39th St., New York 18, N.Y.

ELECTRIC WELD TUBE MILLS



The photo shows the tube forming mill and welder of a complete Yoder mill recently installed for an Italian customer. Although it looks very much like a standard Yoder mill, it embodies special mechanical and electrical innovations designed for *tube production at speeds up to 350 fpm*—from 200 to 300% faster than heretofore considered practical by the resistance-weld process.

This is just one example of the many new things introduced by Yoder in pipe and tube making equipment, to meet widely varying production needs. Other recent Yoder developments are induction weld mills for making steel as well as nonferrous pipe and tubing, at speeds never before approached by this process, and adding greatly to its recognized economic advantages.

For more complete information about the latest technological advances in Yoder tube mill equipment, write, wire or phone

THE YODER COMPANY

5499 Walworth Ave. • Cleveland 2, Ohio

Literature on Request:

- ☐ **1.** Electric Weld Tube Mills for *Steel Tubes* up to 4" diameter.
- ☐ **2.** *Induction Weld* Tube Mills—sizes up to 8" diameter for aluminum, nickel, copper, brass, inconel, monel, stainless and other alloys.
- ☐ **3.** *Pipe Mills*—electric weld—for sizes up to 24" diameter.

ENGINEERING YODER MANUFACTURING

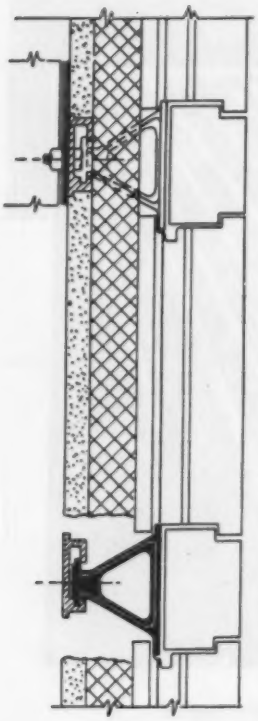
PIPE AND TUBE MILLS—Electric Weld

ROTARY SLITTING LINES

COLD ROLL FORMING MACHINES

INTRODUCING
BIGELOW-LIPTAK'S
BI-MET*

Insulated Furnace Walls For High Temperature Applications

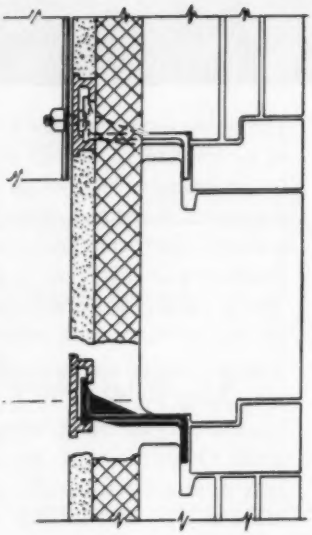


The 4½ inch wall

Here's a job-proven idea which is designed to pare the costs of suspended furnace enclosures. It's used when temperatures are going to be high and when expensive special alloy supporting castings must be used.

Two different castings are used. The first, an alloy clip casting is embedded in the tile where temperatures are highest. This, in turn, is fastened to a standard cast iron support. The design permits the most economical use of costly alloys.

This is a Bigelow-Liptak BI-MET wall and it is another example of B-L's efforts to produce quality furnace enclosures at lower and lower initial costs. Remember: a suspended enclosure for a boiler, a refinery heater, or any other type of installation, will *last longer, have less down time for repairs.* That makes a suspended job the cheapest in the long run. Want to cash in on savings like these? Contact the B-L office nearest you.



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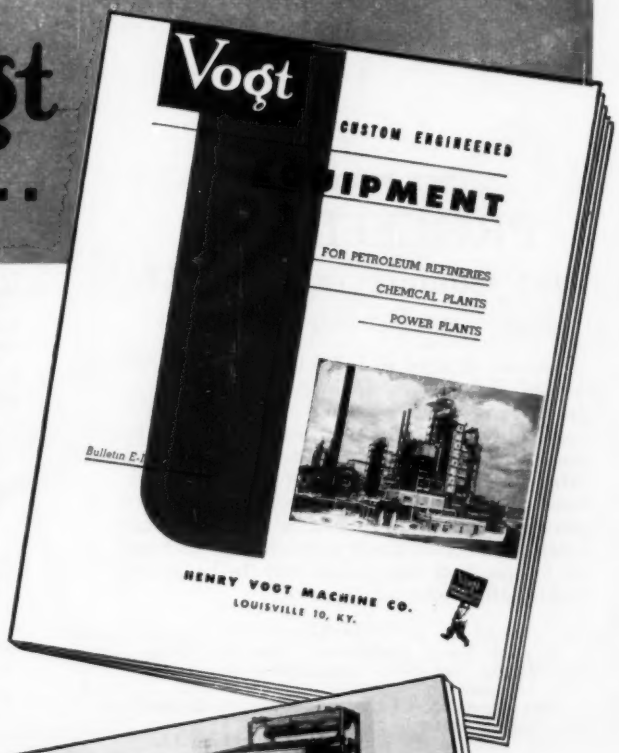

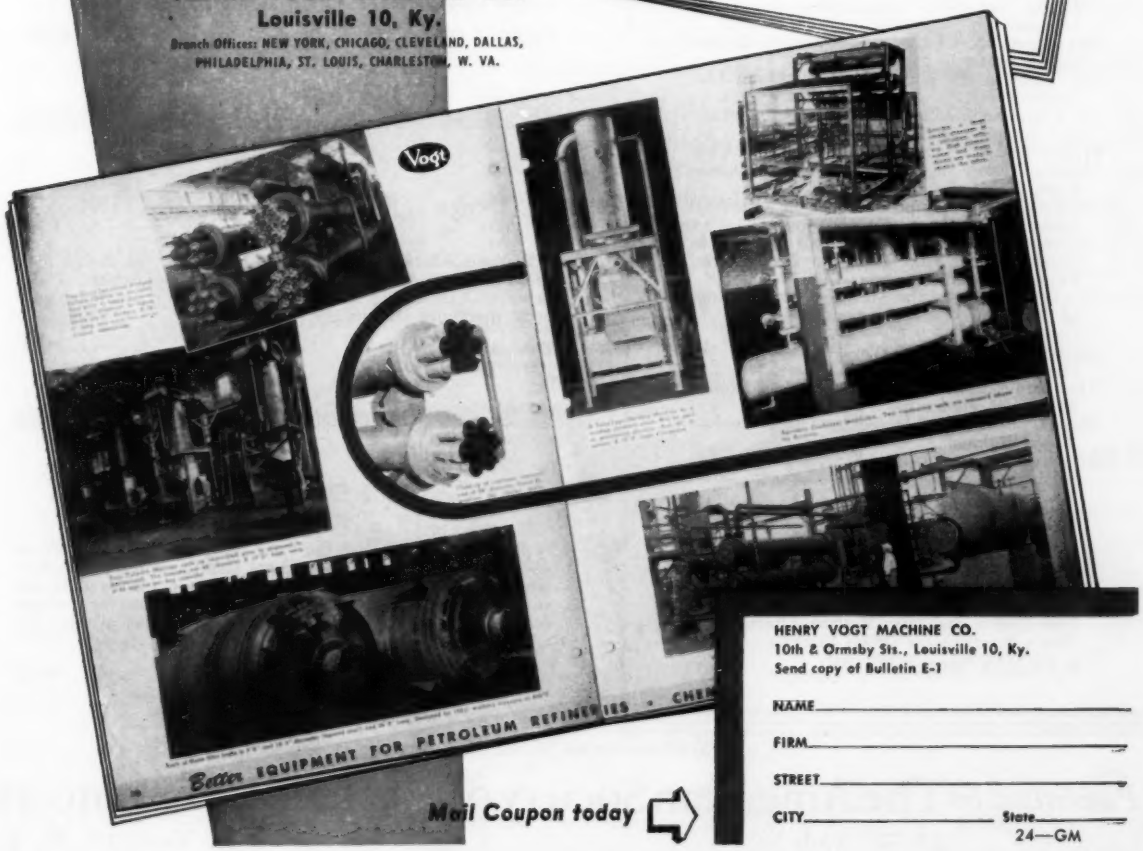

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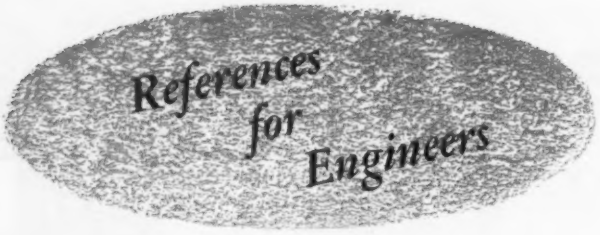

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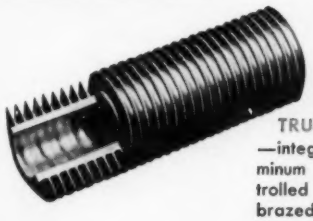

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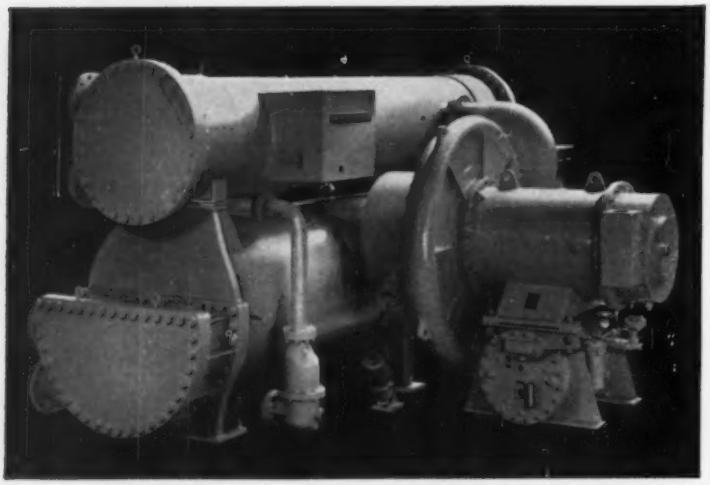

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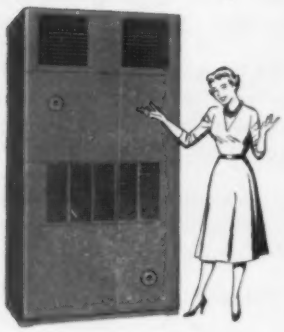

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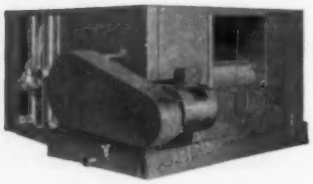

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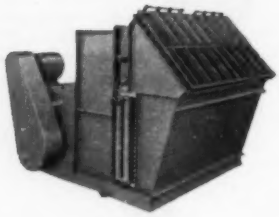

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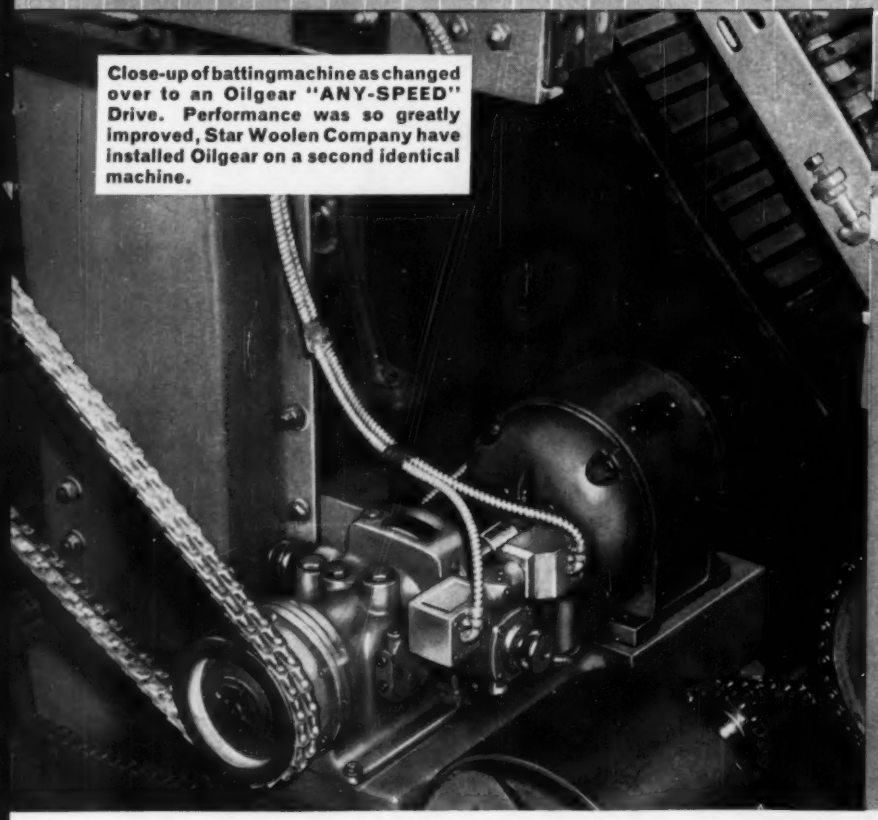
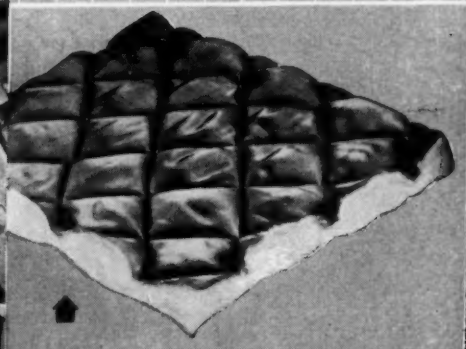
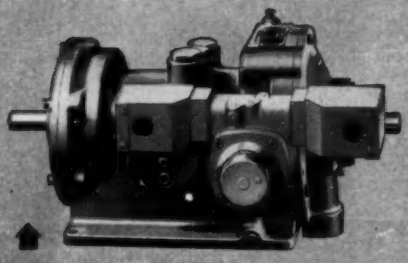


Close-up of batting machine as changed over to an Oilgear "ANY-SPEED" Drive. Performance was so greatly improved, Star Woolen Company have installed Oilgear on a second identical machine.



NY-SUL-LITE (nylon batting) material manufactured by Star Woolen Company and used in famous make sports jackets, snow suits, and comforters.



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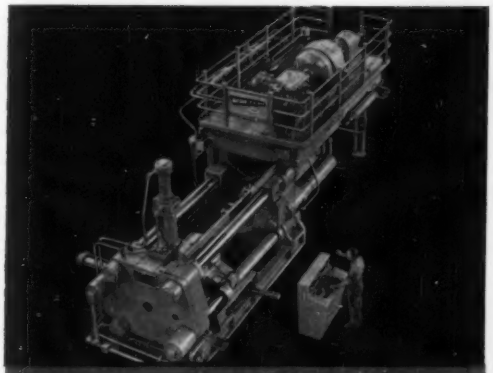

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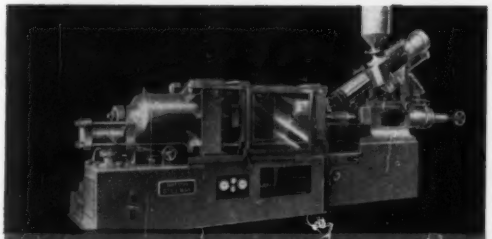

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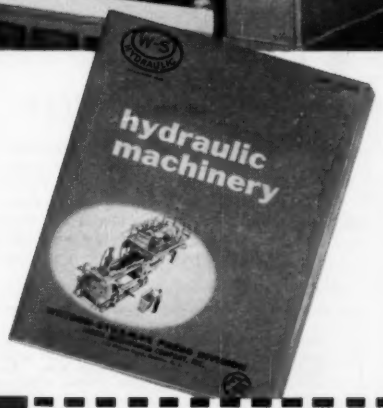

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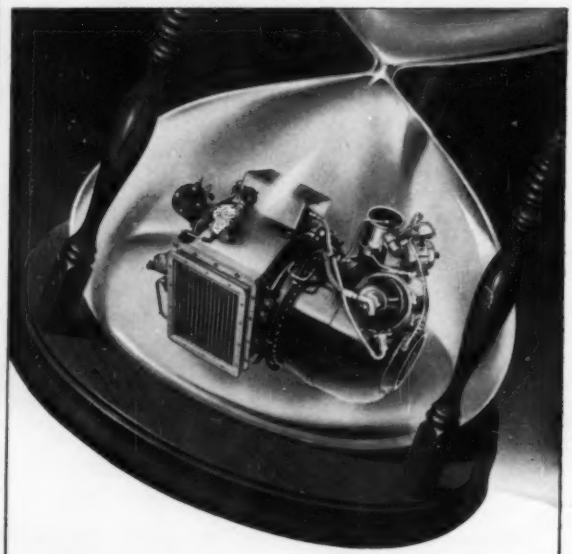

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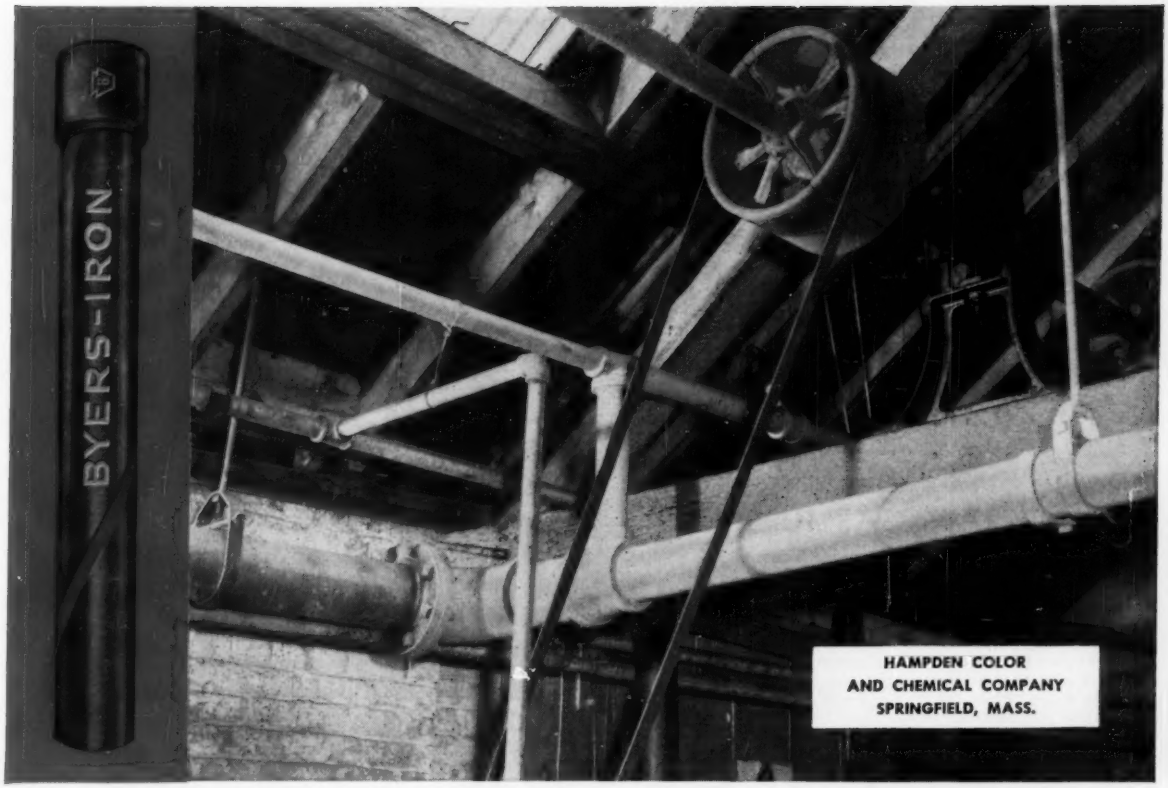

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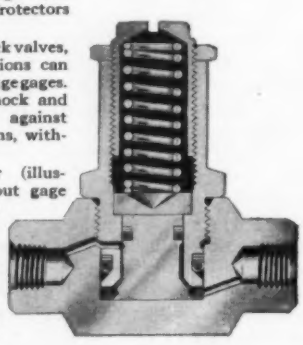

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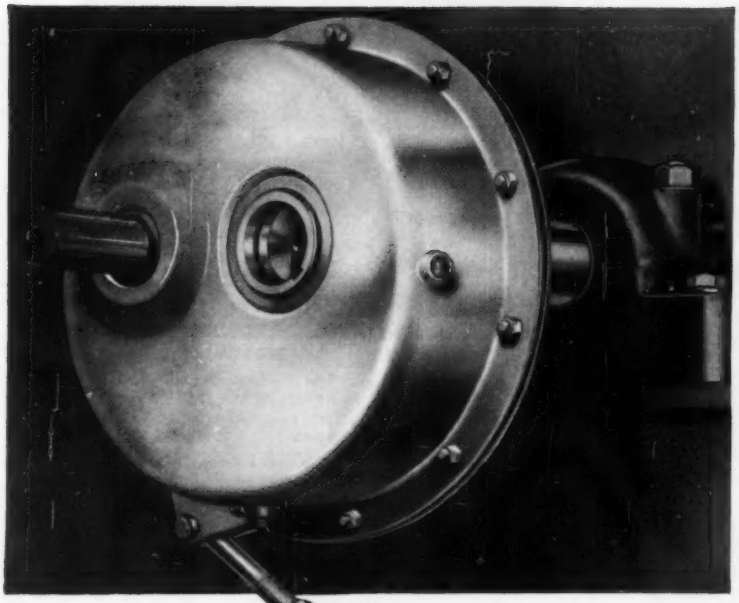

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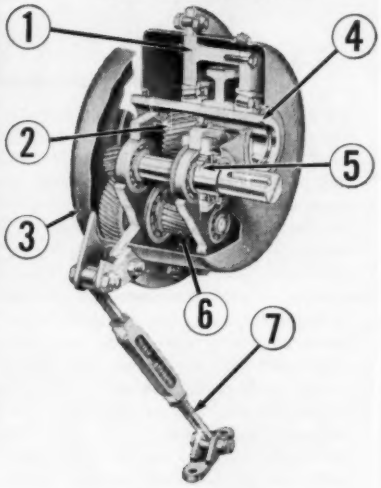

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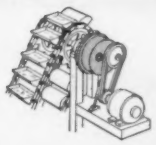

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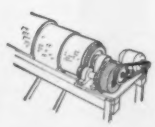

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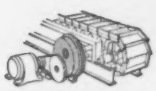

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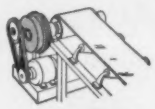

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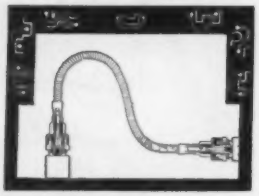

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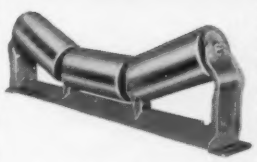

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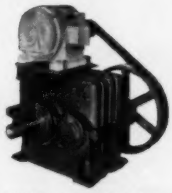

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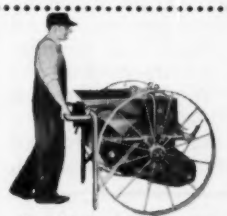

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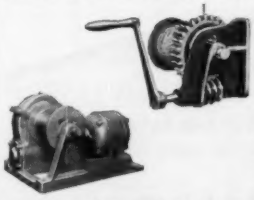

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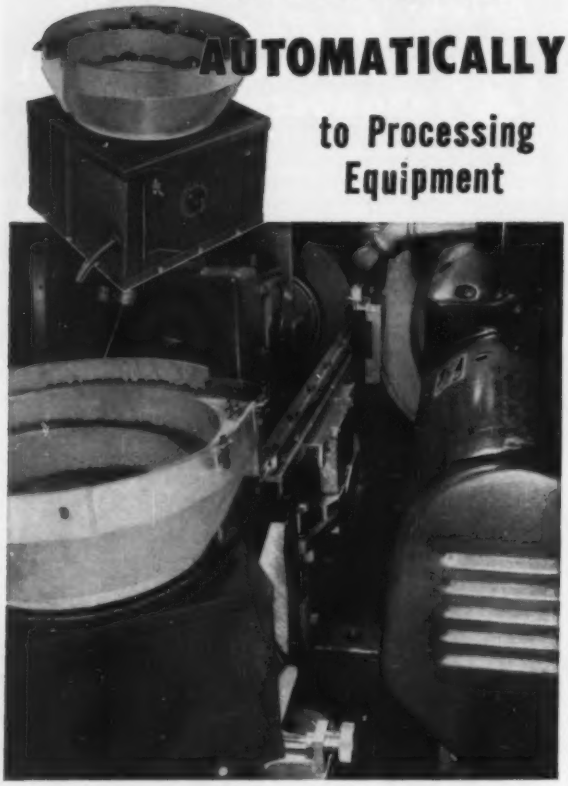

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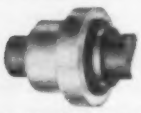

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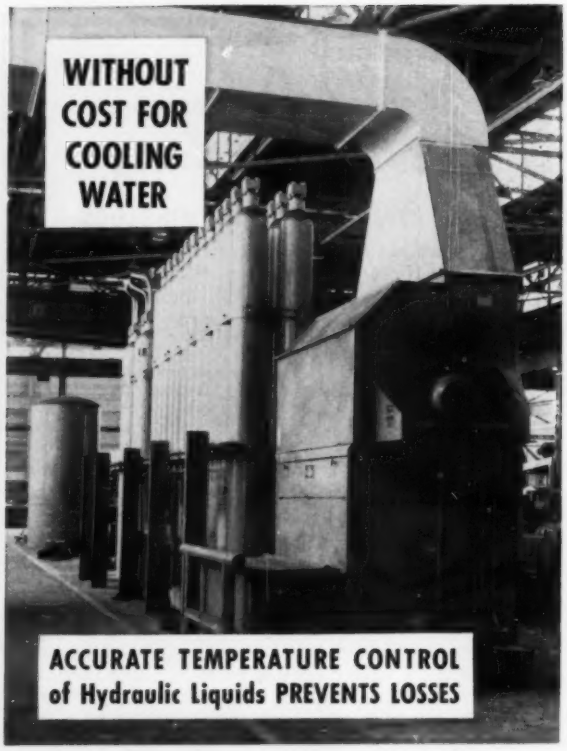

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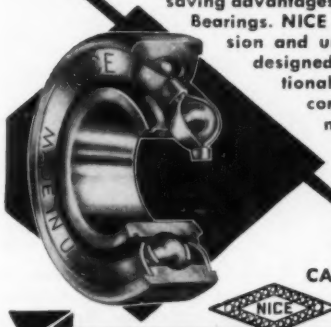

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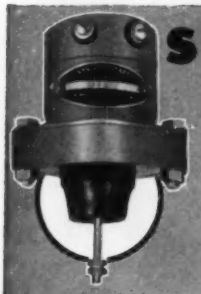

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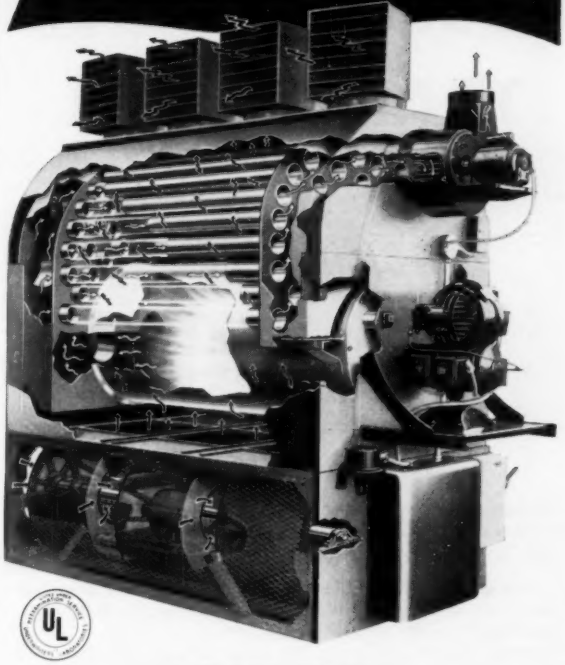

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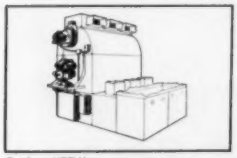

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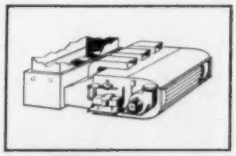

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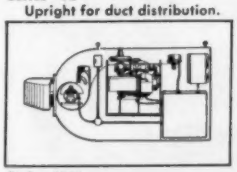
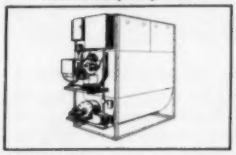


Series "H" Horizontally suspended.



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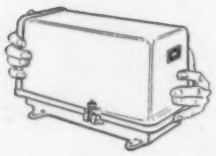

TAYLOR'S years of experience and knowledge of the requirements of the processing industries are reflected in this ingenious electronic-pneumatic instrument. The TRANSET* Potentiometer Transmitter can be used with a wide variety of electrical primary elements. It is especially adaptable where conditions require pneumatic controllers and receivers and where conventional measuring circuits have not proved adequate. Check these features:

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4. Normal Load is automatically inserted when amplifier is removed for service.
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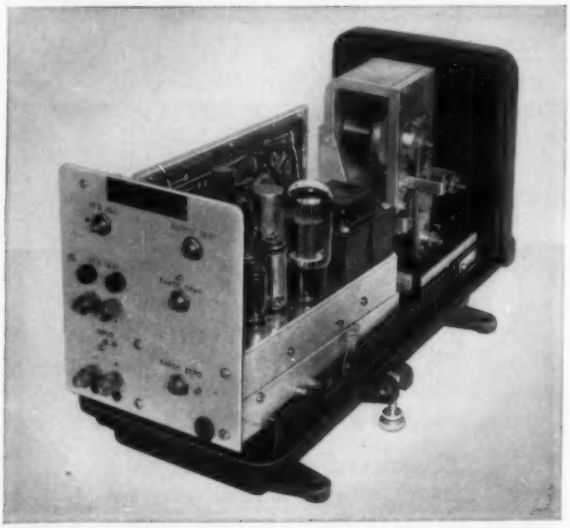
Plugging in the Input Circuit Board. It can be quickly adapted for use with different primary elements by simply plugging in the corresponding input circuit; e.g., for thermocouple applications cold junction compensation is provided in the plug-in circuit board. One instrument can therefore be used as a spare wherever a transmitting potentiometer is used.

Plugging in the Transducer. This exclusive plug-in feature applies to both the transducer and the amplifier. Means quick, easy removal for service; minimum instrument down-time; checking can be done in the shop where full facilities are available. Also permits separate calibration.



Plugging in the Amplifier. See how easily units are locked into the chassis. Also note screwdriver adjustment of range span and zero suppression by use of unique potential dividers. Exclusive Taylor vernier adjustment permits resolution of 1 part in 100,000. Transducer can be omitted when only logging and scanning or other auxiliary electrical functions are required.

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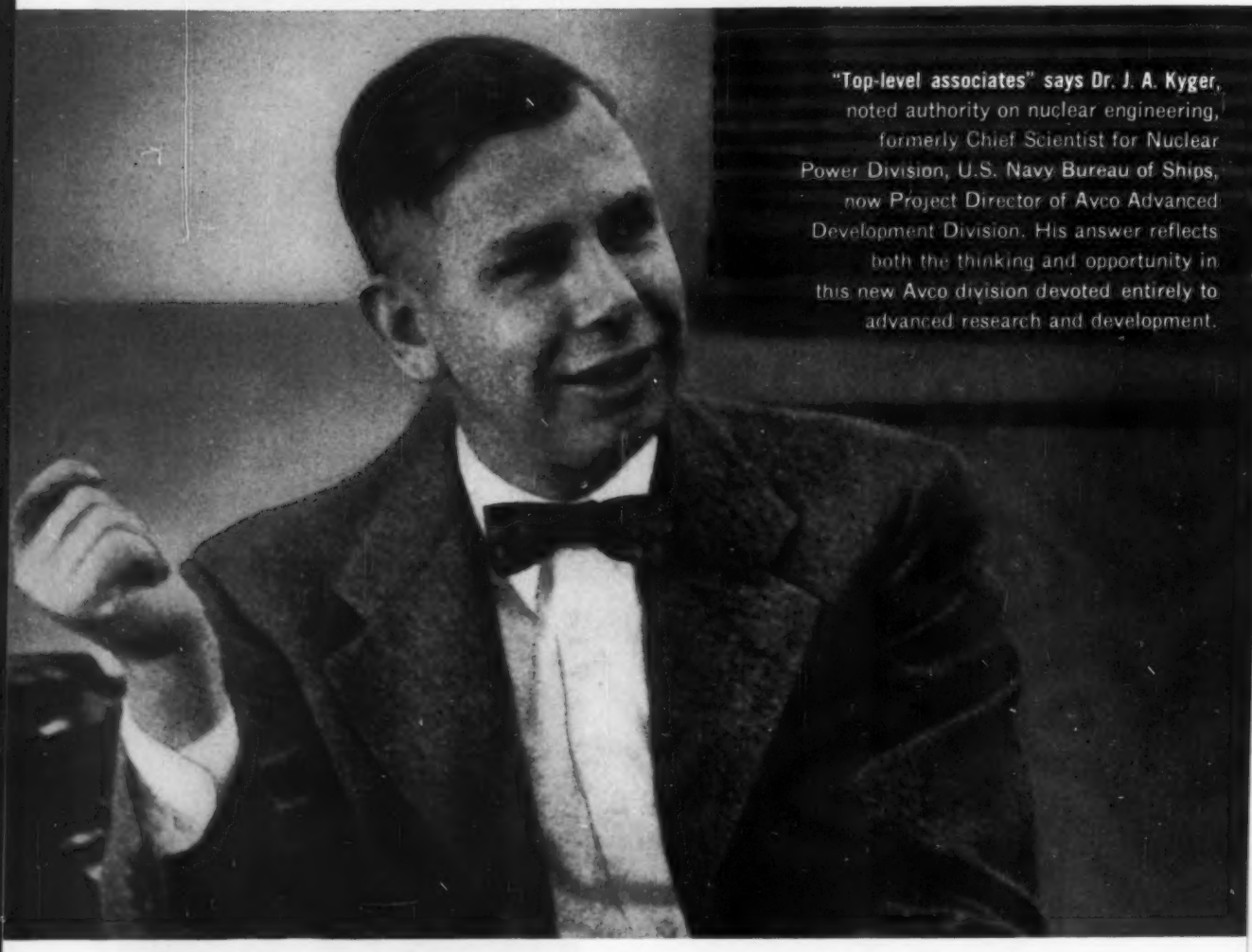

"Top-level associates" says Dr. J. A. Kyger, noted authority on nuclear engineering, formerly Chief Scientist for Nuclear Power Division, U.S. Navy Bureau of Ships, now Project Director of Avco Advanced Development Division. His answer reflects both the thinking and opportunity in this new Avco division devoted entirely to advanced research and development.

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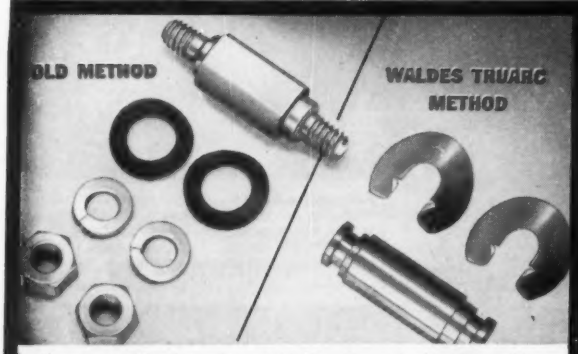
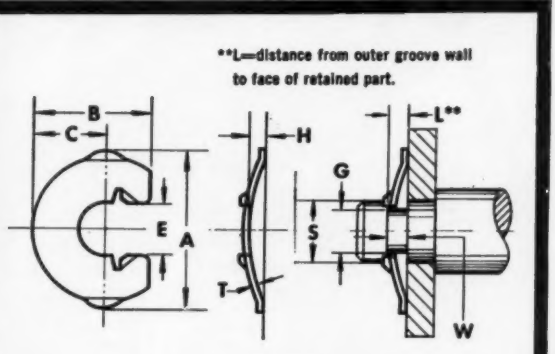
combine the scientific skills, and production facilities of 3 great divisions of Avco Manufacturing Corp.: Avco Advanced Development; Crosley; Lycoming—which currently produce power plants, electronics, air-frame components, and precision parts.

New Waldes Truarc locking-prong ring functions as spring, shoulder, fastener...and STAYS PUT!



Above assembly shows how 2 Waldes Truarc Locking-Prong Rings (Series 5139) replaced 6 parts...eliminated threading operation... and need for skilled labor.



WALDES TRUARC LOCKING-PRONG RING (Series 5139)
U. S. Pat. Pending

Ring No. 5139-	SHAFT Dia. S	tol.	RING DIMENSIONS A	tol.	B	tol.	C	tol.	E	tol.	H	tol.	T†	tol.†	average ultimate shear strength lbs.*	GROOVE DIMENSIONS Dia. G	tol.	Width W	tol.	L min.	L max.	resilient end play take up L max–L min
12	.125	±.002	.340	±.010	.307	±.010	.166	±.005	.086	±.004	.050	±.010	.010	±.0013	400	.082	±.0015	.045	+.005	.035	.045	.010
★15	.156	±.003	.380	±.010	.330	±.010	.184	±.005	.108	±.004	.055	±.010	.010	±.0013	600	.104	±.002	.050	+.005	.035	.045	.010
18	.188	±.003	.445	±.010	.390	±.010	.213	±.005	.130	±.005	.060	±.010	.015	±.0015	900	.124	±.002	.065	+.005	.045	.055	.010
25	.250	±.003	.581	±.010	.500	±.010	.280	±.005	.172	±.005	.070	±.010	.015	±.0015	1000	.165	±.002	.070	+.005	.050	.065	.015
31	.312	±.003	.744	±.010	.620	±.010	.360	±.005	.234	±.005	.095	±.010	.018	+.001 −.002	1300	.228	±.003	.080	+.005	.080	.095	.015
★37	.375	±.003	.853	±.015	.740	±.010	.427	±.005	.280	±.005	.130	±.010	.020	±.002	1900	.270	±.003	.105	+.005	.090	.115	.025
★43	.438	±.003	.960	±.020	.820	±.020	.475	±.010	.327	±.010	.130	±.010	.020	±.002	2200	.327	±.003	.105	+.005	.095	.120	.025

Additional Sizes Under Development ★Production dies not available as of date of printing †Applies to unplated rings only *Recommended safety factor =3 to 4.

The Waldes Truarc Locking-Prong Retaining Ring is a new, low cost, radially applied fastener which can be locked positively in its groove and used as a shoulder against rotating parts. It is primarily intended for use in the automotive, electronic and aeronautical industries.

This radially applied ring locks positively in its grooves by means of two prongs at the open end. Because of its high thrust-load capacity the Waldes Truarc Locking-Prong Ring may be used as a shoulder against rotating parts. Its bowed construction provides for end-play take-up in the assembly and makes less critical the tolerances required for the parts being fastened. Since it serves as a spring as well as a shoulder, this ring eliminates the need for springs, washers, and other accessory fastening devices.

Whatever you make, there's a Waldes Truarc Retaining Ring designed to improve your product...to save you material, machining and labor costs. They're quick and easy to assemble and disassemble, and they do a better job of holding parts together. Truarc rings are precision engineered and precision made, quality controlled from raw material to finished ring.

36 functionally different types...as many as 97 different sizes within a type...5 metal specifications and 14 different finishes. Truarc rings are available from 90 stocking points throughout the U. S. A. and Canada.

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Waldes Kohinoor, Inc., 47-16 Austel Place, L.I.C. 1, N.Y.

☐ Please send me sample Locking-Prong Rings. (please specify shaft size_____)

☐ Please send me supplement No. 1 which brings Truarc Catalog RR 9-52 up to date.

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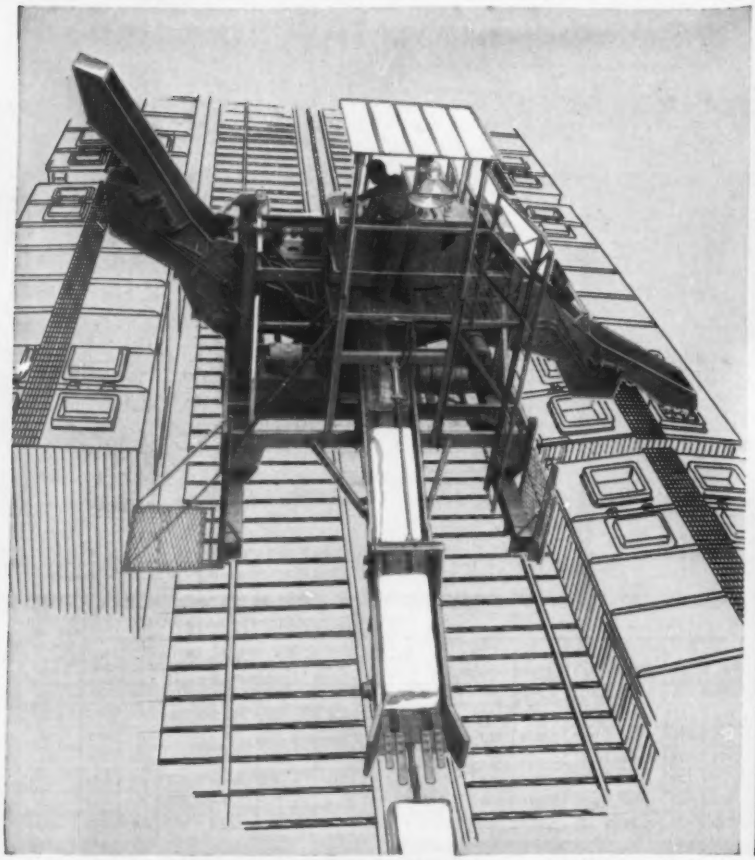
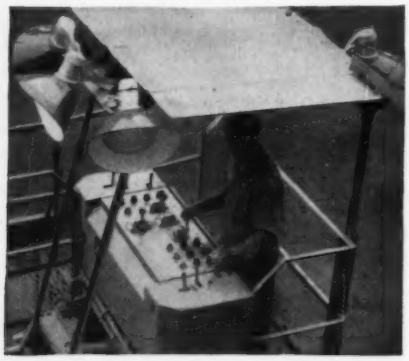
ME-055

WALDES TRUARC Retaining Rings, Grooving Tools, Pliers, Applicators and Dispensers are protected by one or more of the following U. S. Patents: 2,382,948; 2,411,426; 2,411,761; 2,416,852; 2,420,921; 2,428,341; 2,439,785; 2,441,846; 2,455,165; 2,483,379; 2,483,380; 2,483,383; 2,487,802; 2,487,803; 2,491,306; 2,491,310; 2,509,081; 2,544,631; 2,546,616; 2,547,263; 2,558,704; 2,574,034; 2,577,319; 2,595,787. and other U. S. Patents pending. Equal patent protection established in foreign countries.



One man controls all operations of Model 55 Car Icer. These include machine travel (up to 300 feet per minute in either direction), start and stop of dock conveyor, raising and lowering of pick-up conveyor and discharge chutes, ice sizing and operation of flop gate to feed ice into desired roof hatch. Machine also features hydraulic track brakes which assure smooth, positive positioning.



Elevated platform allows operator full visibility in all directions. Controls are within easy reach, functionally grouped to simplify operation. Lights permit top-speed icing around the clock.

Write for Folder 2643 on the New Link-Belt dock-type car icer, adaptable to typical existing docks from 12 to 18 feet in width and of any length—and to cars of all heights, hatch covers of all types.

Faster icing of refrigerator cars

New Link-Belt car icer mechanizes existing docks... fills bunkers with coarse, crushed or chunk ice automatically

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If your business is concerned with transportation of perishable foods, call your nearest Link-Belt office. Or write LINK-BELT COMPANY, Dept. AV, Prudential Plaza, Chicago 1, Ill.

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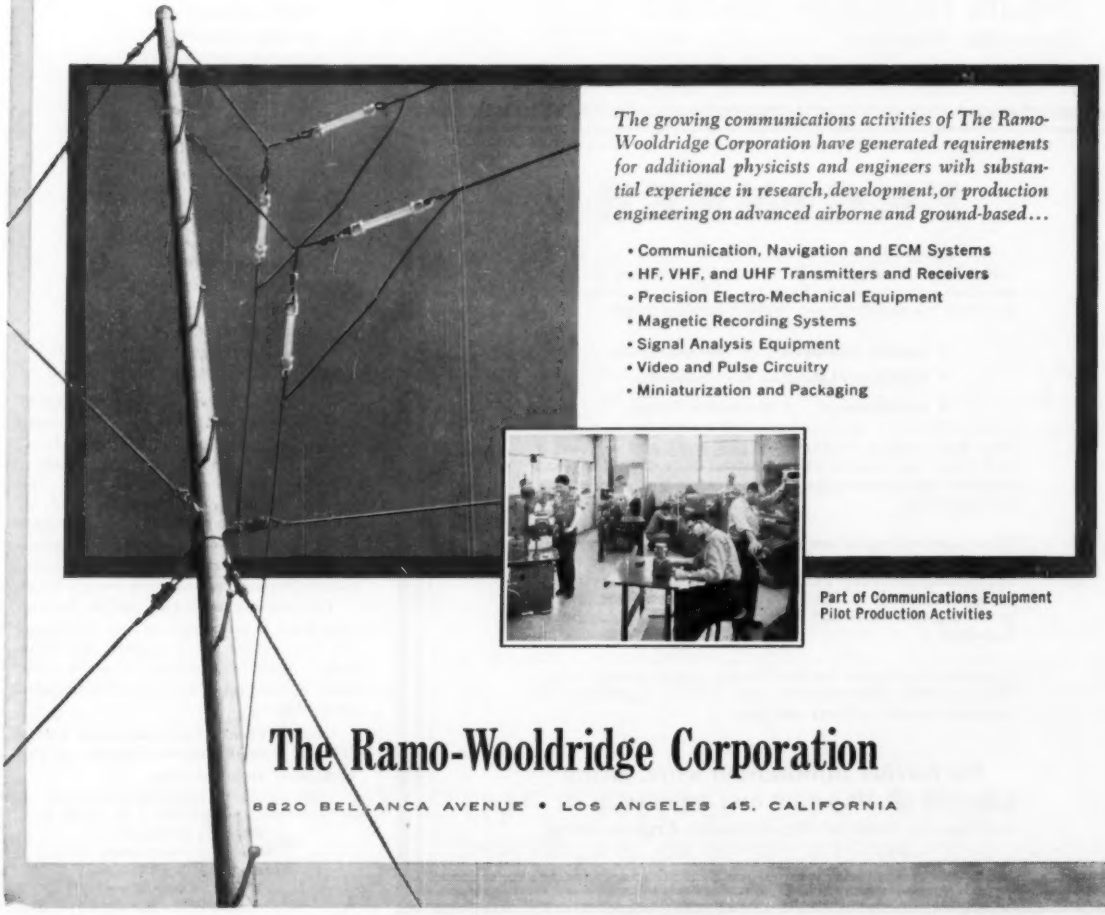

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... there's no limit to the opportunities open to you as members of the OMAR team in the fields of:

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Propellants and Fuels
Testing and Evaluation

Positions are open for the following:

mechanical engineers
combustion engineers
aeronautical engineers
stress analysts
turbine engineers
thermodynamicists
servo engineers
electrical engineers
nuclear engineers
ordnance engineers
instrumentation engineers
test engineers
development engineers
process design engineers
production engineers
physicists
mathematicians
organo-metallic specialists
inorganic chemists
organic chemists
polymer chemists
electrochemists
physical chemists
analytical chemists

On the OMAR team, you're affiliated with pioneers in the field of supersonic propulsion: **Reaction Motors, Inc.**, first in the American rocket industry; **Marquardt Aircraft Company**, the West's largest jet research and development center and first in ramjets; **Olin Mathieson Chemical Corporation**, a leading producer of chemicals, metals, explosives, and high-energy fuels.

You're on a team that unites for the first time both chemical and mechanical experience in research, development, and production of supersonic rockets, ramjets, and liquid and solid propellants.

For further information write *OMAR Employment Officer* at the company nearest you.

Olin Mathieson Chemical Corporation
466 Park Avenue, New York 22, N. Y.
Reaction Motors, Inc.
Denville 4, New Jersey
Marquardt Aircraft Company
16557 Saticoy Street
Van Nuys, California

3907

ENGINEERS KNOW

good things keep coming

from CHRYSLER CORPORATION

And good things are happening to many people here. We're expanding rapidly. New groups are constantly being set up in the fields of automotive design, test, development and research.

We can offer especially interesting career opportunities in gas turbine, reciprocating engine and nuclear power, advanced chassis design, fuel injection systems, automatic transmissions, suspension systems, and test and development work at the famed Chrysler Proving Ground. There's room at Chrysler for experience . . . and ideas. There's room to grow. And your growth depends solely on what you bring to the job. Whatever your background, we invite you to investigate the many fine positions available with us.

We promise you this. You won't get lost with us, nailed down in some confining slot that limits your growth. We give our engineers and scientists the greatest variety of work that brings the experience needed for fast advancement.

These are permanent, non-military positions in *civilian programs*, with security for the future. Chrysler Corporation is the largest employer in the city of Detroit, and its leadership position in the industry makes it the choice place to work.

Why not decide right now to find out more about these attractive opportunities? That's all we want you to do. Simply write Mr. L. C. Bettega of Chrysler Engineering at P. O. Box 1118, Detroit 31, Michigan. Write today!

ENGINEERING DIVISION

CHRYSLER CORPORATION

P. O. BOX 1118, DETROIT 31, MICHIGAN

MECHANICAL ENGINEER

Large engineering and construction firm located in New York has staff position open for Mechanical Engineer with experience in steam electric station operation to engage in plant betterment work which involves assistance in starting new units, testing, advising and consulting in respect to operating problems, improving steam plant efficiencies, advising in respect to procedures and maintenance practices, and related problems. Reasonable knowledge of water treatment problems, practices, etc. desirable.

Substantial travel involved. Salary commensurate with experience. Attractive company benefits.

Give full particulars, age, education, experience in detail, and salary expected.

Address CA-5538, care of "Mechanical Engineering"

WANTED

Industrial engineer with metallurgical or mechanical engineering background, between 30 and 35, with executive ability, to be trained in the capacity of Assistant to Works Manager. One of Colorado's largest progressive jobbing plants, manufacturing heavy industrial equipment and operating foundry, machine shop and plate shop. Splendid future for the right man. State full qualifications and experience in first letter.

Address CA-5574, %"Mechanical Engineering"

Barber-Greene has opportunities for ENGINEERS

Openings include design, development, field engineering and sales opportunities in conveying, ditching, and asphalt equipment fields.

Opportunities for both experienced and inexperienced mechanical and civil engineering graduates.

Training program available to supplement technical background and experience.

Barber-Greene is one of the outstanding growth companies, which offers life-time careers to outstanding men.

Submit resume outlining background, salary desired, etc., to: Personnel Manager

Barber-Greene BG

AURORA, ILLINOIS

REFRIGERATION AND AIR CONDITIONING ENGINEER

Graduate M.E. with minimum 8 years' broad experience in refrigeration and air conditioning design and project work. To render technical service to operating units and serve as staff consultant on air conditioning and refrigeration problems related to overseas operations located in Saudi Arabia.

Facilities include large central air conditioning plant with chilled water distribution system through entire communities for residential and industrial air conditioning totaling 14,000 tons capacity plus 700 tons of refrigeration for manufacture of ice and storage of commissary supplies.

Must be capable of developing and carrying work assignments to completion. For assignment in New York Engineering Office, occasional field trips required.

Write outlining work experience and personal history.

Recruiting Supervisor, Box 123

ARABIAN AMERICIAN OIL COMPANY
505 PARK AVENUE
NEW YORK 22, NEW YORK

ENGINEERS

Qualified to join the SELECTED FEW? . . . who will develop

ATOMIC ENGINE APPLICATIONS FOR AIRCRAFT at General Electric

For a strategic position in a field of immeasurable potentialities—nuclear powered flight—the engineering world offers few opportunities equal to these new positions at General Electric.

This company is engaged in more areas of atomic development than any other, and capable, therefore, of giving engineers the widest possible view of nuclear developments. And the Aircraft Gas Turbine Division of GE is an acknowledged pioneer in the development of radically new power plants . . .

. . . the first jet engines in the U. S. (built in 1943) and their ever more powerful successors . . .

. . . for the last decade, rocket engines—and currently a rocket motor for the first man-made satellite . . .

. . . and NOW an intensive program aimed at bringing the world of nuclear flight into being years sooner than has been contemplated by the most optimistic experts . . .

Top Salaries Paid—100% Tuition Refund Policy for Advanced Study. Notable Benefit Program.

If you are a graduate engineer, interested in working on turbojet machinery for atomic aircraft, GE would like to discuss an opening with you. Please write Mr. S. Bell, Aircraft Gas Turbine Div., General Electric, Cincinnati 15, Ohio

GENERAL ELECTRIC

ENGINEERS

NEW 2-FOLD
RETIREMENT INCOME PLAN

for Aviation and Missile Engineers

It's natural that a long-time leader in aviation, like Republic—with many firsts to its credit—should be a leader, too, in providing for the welfare of its staff. Right in line with this forward-looking policy is the remarkable new Republic Retirement Income Plan. Here is how it works:

PART 1 *is a basic Retirement Income plan paid for* entirely *by Republic Aviation.*

PART 2 *is a cooperative effort. It is completely optional. But if an engineer wishes to increase his retirement fund, by making a small monthly payment, Republic will* MORE THAN MATCH *his contribution.*

Take the case of a hypothetical engineer who joins Republic on January 1st, 1956, averages $8,000 a year for 15 years; then retires aged 65. If he elected PART 2 of the plan, he will have a total *monthly retirement income of $225.80,* including his social security. For this he himself will contribute *only $8.50 a month* to the Republic Retirement Income Plan.

Of course, the MORE YOU EARN, the HIGHER your Retirement Income will be. And Republic pays a top salary scale in the industry.

...RETIREMENT PLAN JUST ONE OF MANY PLUS FACTORS POINTING TO A REPUBLIC CAREER

FIRST —there's the interest and prestige of working for a pioneer in aircraft design, creator of such famous planes as the F-84 Thunderjet, the F-84F Thunderstreak, RF-84F Thunderflash and XF-84H. (Soon to be followed on the production line by the new F-103, F-105 and RF-105.)

SECOND —the company is expanding sharply, providing frequent opportunities for able men to advance. In fact a $12,000,000 increase in the Research and Development Program has just been announced.

THIRD —an All-Expense Paid Relocation Plan for qualified engineers living outside the New York City and Long Island areas, which makes it easy to move to Republic. Other liberal benefits: Life, Accident and Health Insurance; Hospital-Surgical Benefits for the whole family; educational aid covering ⅗ the cost of collegiate and graduate study.

Serve your own best interests. Make full inquiries into the many advantages of joining Republic now, not the least of which is living on Long Island—the Playground of the East.

Important engineering positions are now open at all levels:

STAFF ENGINEERING
PRELIMINARY DESIGN
ELECTRONICS
WEAPONS SYSTEMS PROPOSALS
OPERATIONS RESEARCH
SYSTEMS
MATHEMATICAL ANALYSES
AERODYNAMICS
TECHNICAL WRITING
DYNAMICS
ELECTRO-MECHANICAL DESIGN
FLIGHT TEST
RESEARCH
THERMODYNAMICS
FLUTTER & VIBRATIONS
STRESS
AIRCRAFT DESIGN
WEIGHTS
DESIGNERS:
Electrical
Airframe
Mechanical

Please address complete resume outlining details of your technical background to:

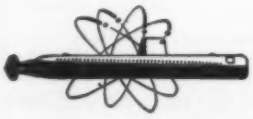
REPUBLIC AVIATION

AIRCRAFT
Assistant Chief Engineer, Administration, **Mr. R. L. Bortner**
Farmingdale, Long Island, N. Y.

MISSILES
Administrative Engineer, Mr. Robert R. Reissig
Hicksville, Long Island, N. Y.

MECHANICAL ENGINEERS

What Should an ME Know About Atomics?



Quite a bit these days, with so many companies getting into the field. While many new firms are now starting to explore the field, Electric Boat Division of General Dynamics Corporation led the way with the building of the first nuclear powered submarines, Nautilus and Sea Wolf.

In addition to increasing its engineering force for work on new and greatly advanced nuclear submarines, Electric Boat is expanding Research and Development operations to include the development of additional practical uses for nuclear energy.

Right now Electric Boat has interesting positions for Mechanical Engineers with experience in vibration and shock, machine design, stress analysis, hydraulics, rotating machinery, power plants or air-conditioning and piping.

Study for bachelor's or advanced degrees is encouraged at Electric Boat, with courses in mathematics, naval architecture, nuclear engineering and nuclear submarine systems offered within the plant, and tuition paid by the company for study in these or other fields at leading colleges and universities.

Men interested in these openings should write complete details of background and experience including initial salary requirements. Interviews will be arranged promptly for qualified applicants. Address Mr. Peter Carpenter.

Electric Boat Division

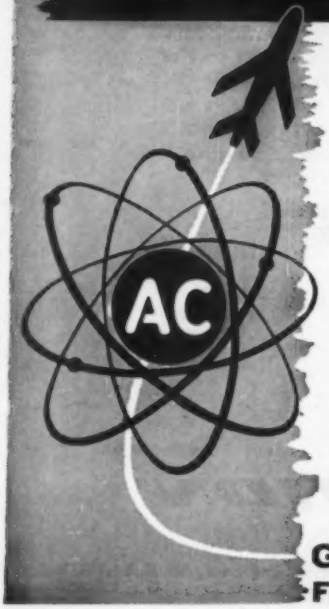
GENERAL DYNAMICS CORPORATION

GROTON — **CONNECTICUT**

near New London on the Connecticut shore

ENGINEERS and DESIGNERS NEEDED

for: MISSILE GUIDANCE SYSTEMS · BOMBING NAVIGATIONAL COMPUTER SYSTEMS · NEW CIVIL AVIATION PRODUCTS · JET AND TURBO-PROP ENGINE CONTROLS · AIRBORNE FIRE CONTROLS



GM CAREER OPPORTUNITIES IN

Systems Engineering and Analysis
Experimental Engineering
Development Engineering
Project Coordination
Design Engineering
Product Engineering
Product Evaluation
Field Engineering

AND WE ALSO NEED:

DESIGNERS • CHECKERS • LAYOUT MEN

Positions Are Permanent — **Excellent Advancement Opportunities**

Every inquiry treated confidentially and given immediate attention and personal reply.

WRITE TODAY FOR EMPLOYMENT APPLICATION

Mr. John F. Heffinger
Supervisor of Salaried Personnel

AC SPARK PLUG
THE ELECTRONICS DIVISION

GENERAL MOTORS CORPORATION

Flint 2, Michigan — **Milwaukee 2, Wisconsin**

ENGINEERS

for immediate placement

ELECTRICAL ENGINEERS
MECHANICAL ENGINEERS
ELECTRONIC ENGINEERS
COMPUTER ENGINEERS
SOLID-STATE PHYSICISTS

Engineering at NCR:

1. Immediate, permanent positions in Mechanical Engineering, Electrical Engineering and Physics Research Divisions.

2. Engineering project work in Adding Machines, Cash Registers, Accounting Machines, Computers and related Data Processing Equipment in Dayton, Los Angeles, and Ithaca, New York.

3. Opportunities in design, development, production-engineering and packaging of mechanical, electronic, and electromechanical devices.

4. Some experience in development, design, and application of high-speed, light-weight mechanisms of the intermittent-motion type; or, experience in digital devices and components, is desirable, but not essential.

5. Ample training and indoctrination is available to all employees.

As an NCR engineer you, with your family, will enjoy:

1. UNLIMITED OPPORTUNITY in the broad, ever-expanding field of Business Machine Engineering and Research.

2. AN EXCELLENT SALARY, plus exceptional benefits of lifetime value for you and your family.

3. A RECREATIONAL PROGRAM for year-round enjoyment of the entire family, including a new NCR Country Club with 36 holes of golf, and a 166-acre employees' park for outings with swimming, boating, and supervised play for the children.

4. LIVING IN DAYTON . . . considered a clean, attractive, progressive city with outstanding school facilities.

5. YOUR WORK AT NCR with its friendly, family atmosphere, with its employee morale at a very high level, and with people who, like yourself, have decided to build their professional future with NCR.

National*

ACT AT ONCE — Send résumé of your education, experience and geographic preference to:

EMPLOYMENT DEPARTMENT, TECHNICAL PROCUREMENT SECTION 2

THE NATIONAL CASH REGISTER COMPANY
Dayton 9, Ohio

*Trade-Mark—Reg. U. S. Pat. Off.

ENGINEER

Mechanical Components and Systems Design for Aircraft Nuclear Propulsion

The application of atomic power to aircraft may have as widespread and important an effect as the introduction of the jet engine little more than a decade ago. This opportunity with General Electric's ANP Department means a chance for a qualified engineer to enter this new field at its very beginning.

Assignments will involve the design of mechanical components and systems for use with aircraft nuclear power plants. For this work an ME degree or equivalent is needed, plus 3 to 5 years' experience in design of mechanical devices, structures or systems analysis. Though not essential, work in aircraft power plant field is especially desirable.

Publication of research results in the appropriate classified or open literature is encouraged.

Openings in **Cincinnati, Ohio** *and* **Idaho Falls, Idaho**

Address Reply to Location You Prefer

Aircraft Nuclear Propulsion Dept.

GENERAL ELECTRIC

Att: W. J. Kelly
P. O. Box 132
Cincinnati, Ohio

Att: L. A. Munther
P. O. Box 535
Idaho Falls, Idaho

EXPERIENCED DESIGNERS— LAYOUT MEN

To Work At General Motors New Technical Center

For Experimental Automotive Work in Transmissions, Engines & Chassis.

The Engineering Staff is located in the Suburbs of Detroit on an 820 acre site devoted to research and development work. Splendid opportunity for men looking toward the future. Ideal working conditions in well lighted, air conditioned office building. Fine recreational program with golf course adjacent to site. Opportunity to become a share holder in GM through a generous Stock Purchase Program. Also excellent health insurance, life insurance, and retirement plans.

State full particulars: Age, Experience, Salary Expected, Etc. Send resume to:

Personnel Dept.
Engineering Staff
General Motors Corporation
GM Technical Center
Detroit 2, Michigan

STANDARDS ENGINEER

Attractive opening in Esso Engineering for a Standards Engineer. Will work with a group of engineers preparing engineering standards and standard purchase specifications for oil refinery equipment.

Candidates should be graduate engineers not over 35 years of age. Broad background of at least five years' experience with oil refinery equipment desired.

Give full and specific details of education, experience, desired salary, availability date and references.

All inquiries will be considered promptly and held confidential.

Esso Research and Engineering Company
(Formerly Standard Oil Development Company)
Personnel Division
P. O. Box 51 **Linden, N. J.**

MECHANICAL ENGINEERS

build a career in controls at KEARFOTT

Kearfott has made some outstanding advances to improve the performance and reduce the size of airborne control components and systems ... and Kearfott is growing fast. Here you can advance, while enjoying original and creative assignments.

Another factor which makes rapid promotions possible is Kearfott's decentralization which allows closer management contact and recognition of achievement. The 7 plants in the Passaic-Clifton-Paterson area of northern New Jersey are autonomous, each one a fully integrated unit. This means you get small-company congeniality and flexibility along with the benefits, resources and modern facilities of a large and progressive organization. There's top remuneration, too, at Kearfott, AND a long range future.

An important member of the widely diversified General Precision Equipment Corporation, Kearfott since 1917 has been a leader in the design and development of precision instruments for industry and the armed services. This leadership gives you opportunity to be in on the most advanced work, to grow in professional stature.

Design and Development Positions Available on several levels of responsibility in the following areas of interest: **servo systems, test equipment, servo-mechanisms, gyro systems, computers and gyros.**

Also Positions Bearing Project Responsibility for design and development of static and dynamic packages, such as torquers, take-offs, resolvers, motors, generators, synchros and gear heads.

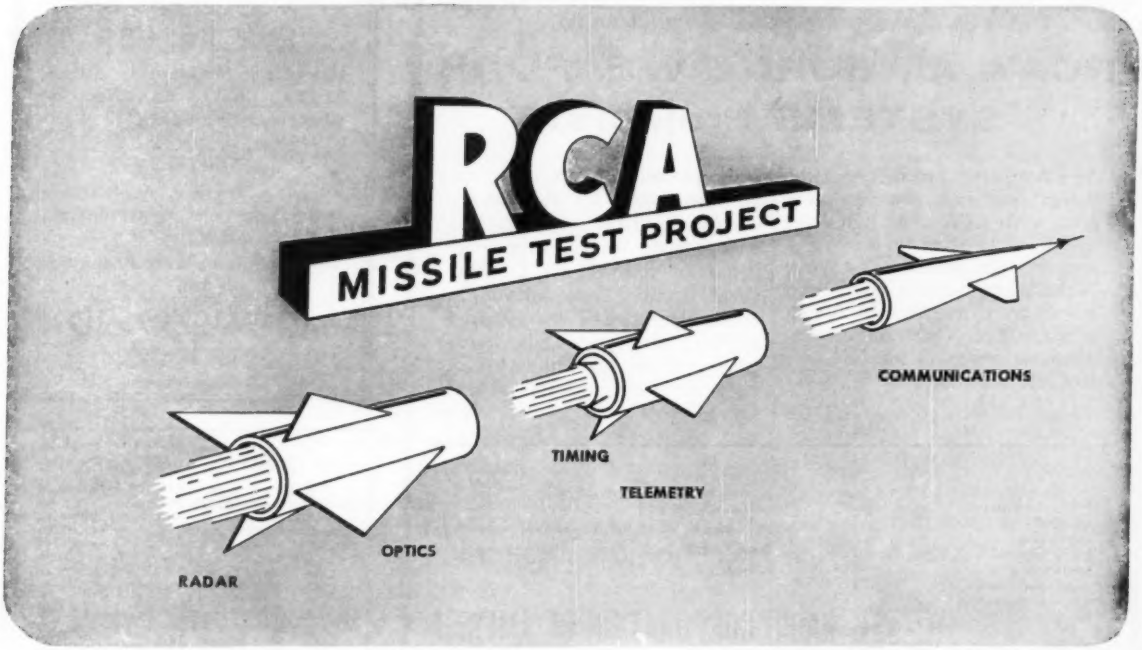
Plan your career in controls today— send complete details to **James M. Butler**

Kearfott COMPANY, INC.

1378 Main Ave.,
Clifton, New Jersey

Subsidiary of General Precision Equipment Corporation

Opto-Mechanical Engineers and Scientists...



There's Great Opportunity for Missile Testing Instrumentation at the World's Largest Missile Testing Laboratory and Range on Florida's East Coast!

The Air Force Missile Test Center stretches from Patrick Air Force Base on Florida's central east coast to the mid-south Atlantic. RCA has full responsibility for instrumentation. And for engineers and scientists who look to a future that's challenging... RCA offers creative positions in ballistic and space-tracking techniques.

Interesting positions in stimulating projects are open *now* for you if you qualify with a Bachelor or Advanced Degree. Experience in electronics instrumentation is desired.

ENGINEERING LEADERS—to direct specialized engineering activities in design and analysis of optical tracking systems and techniques.

OPTO-MECHANICAL ENGINEERS—to determine systematic and variable error in optical instruments, such as motion picture cameras, cinetheodolites, tracking telescopes.

MECHANICAL ENGINEERS—for mechanical engineering of intricate tracking and fixed-camera mechanisms and mounts.

PHYSICISTS—to investigate parameters of photographic visibility through the atmosphere.

FIELD ENGINEER—for practical, on-the-spot engineering of optical tracking systems and components.

You and your family will enjoy Florida climate, living all year long in the famed Cocoa Beach resort area. The RCA benefits program—among the most liberal in the electronics industry—makes your future secure. Relocation assistance, too.

TODAY . . . get complete information on arrangements for a personal interview. Send a complete resume of your education and experience to:

Mr. H. N. Ashby, Technical Employment
Missile Test Project, Dept. N-6C
RCA Service Company, Inc.
P.O. Box 1226, Melbourne, Florida

RCA® RADIO CORPORATION of AMERICA

MECHANICAL ENGINEERS...

You'll find professional stimulation in

RCA's AIRBORNE WEAPONS SYSTEMS Projects!

As a mechanical or aeronautical design engineer, you can now grow with RCA's creative engineers on airborne weapons systems. In addition to your bachelor or advanced degree, you should have experience in design of aircraft structure and mechanisms or design of aircraft control instruments.

These RCA problems call for truly advanced effort. You will be challenged by the severe environmental conditions encountered in the supersonic flight of tomorrow's highest-speed aircraft. New concepts in mechanical design are required to deal with previously unexplored states of temperature, altitude, shock, vibration and humidity.

Plus . . . completely equipped engineering laboratories—advancement on merit—full benefits program—relocation expenses paid.

Please send resume of education and experience to:

Mr. John R. Weld, Employment Manager
Dept. B-6C, Radio Corporation of America
Camden 2, N. J.

RADIO CORPORATION OF AMERICA
DEFENSE ELECTRONIC PRODUCTS

DU PONT *Opportunities for...*

MAINTENANCE ENGINEERS

A limited number of career openings are available to experienced graduate mechanical and industrial engineers in du Pont's centralized Engineering Department in Wilmington, Delaware. Successful applicants will provide consulting service and technical assistance to operating plants on problems in the broad field of engineered maintenance.

Specialized experience in one or more of the following areas is desired:

MAINTENANCE WORK MEASUREMENT. Experience in and responsibility for the application of time data and measurement techniques to maintenance, construction, machine shop, and related fields.

CORRECTIVE MAINTENANCE. Experience in solving mechanical equipment maintenance problems such as lubrication; power transmission; stress analysis and vibration; packing, gaskets and mechanical seals; maintenance materials and protective coatings; and related activities.

MAINTENANCE ENGINEERING. Experience in maintenance procedures, controls, and organization; selection and training of mechanics; shop lay-out; tooling, and fabrication. Background should include both the administration and the engineering of the maintenance function.

Please send complete resume, including details of education and experience, to:

Mr. J. C. Costello, Jr.
Personnel Relations Section
Engineering Department
E. I. du Pont de Nemours & Co., Inc.
• Wilmington 98, Delaware

SEE CHEMSTRAND'S AD ON PAGE 49 OF THIS MAGAZINE

Positions available for

ENGINEERS

(Chemical, Mechanical, Metallurgical, Textile, Industrial, Instrument and Civil) and

CHEMISTS

(Organic, Physical, Analytical—Instrumental and Wet Method, Textile Chemists.)

Write to Technical Personnel Department

THE
CHEMSTRAND
CORPORATION
Decatur, Alabama

MACHINE DESIGNERS

Challenging opportunity for experienced mechanical engineers with creative ability who are capable of conceiving, planning and carrying through to successful completion new and unusual machines related to the field of automation. Good wages plus profit sharing. Close to ideal recreation and vacation spots.

Delos M. Palmer & Associates
Consulting Engineers
4491 Jackman Road
Toledo 12, Ohio

WANTED POWER ENGINEER

Heavy chemicals plant, Upper Ohio Valley, is seeking top notch Mechanical or Electrical Engineers with 2-4 years' power operating experience. Would join organization operating 55,000 KW multi-unit coal-fired station. Opportunities for good men in a fast growing plant.

Address CA-5560, % "Mechanical Engineering."

MECHANICAL OR CHEMICAL ENGINEER

Not over 50 years of age, with five years of responsible experience in design and layout of chemical plant, preferably anhydrous ammonia. Must have had previous experience in making design calculations, preparing specifications, equipment selection for pressure vessels, piping, power equipment, heat exchanges, and compressors. Some knowledge of process design desirable. Good working conditions and employee benefits. Outstanding public school system and university. Send resume, salary requirement, and recent photo to:

Personnel Manager
COOPERATIVE FARM CHEMICALS ASSOCIATION
P. O. Box No. 80 Lawrence, Kansas

to the Engineer who seeks a wide variety of assignments

An unparalleled variety of assignments await you at Lockheed's Engineering Flight Test Division.

Lockheed diversification is the reason. This year alone flight tests must be conducted on new turbo-compound and prop-jet transports, extremely high-speed fighters, new types of jet trainers, patrol bombers, radar search planes and aerological aircraft. In development are jet transports and nuclear applications to aircraft and a large number of completely classified aircraft.

You not only work on many types of aircraft in Lockheed Flight Test, your work within each plane varies widely. Each flight test presents new problems, frequently requires new approaches.

Because of this, personal initiative is welcomed and rewarded at Lockheed.

To non-aircraft engineers:

Aircraft experience is not necessary to join Lockheed. It's your engineering training and experience that count. Lockheed trains you for aircraft engineering—at full pay.

Positions are open for:

AERONAUTICAL ENGINEERS
MECHANICAL ENGINEERS
ELECTRICAL ENGINEERS
PHYSICISTS
ELECTRONIC ENGINEERS
CIVIL ENGINEERS
with and without aircraft experience

Assignments are in fields of:

POWER PLANT: engine and after-burner; fuel systems; oil, fire extinguishing and air conditioning systems.

FLIGHT ANALYSIS: CAA certification, aerodynamic performance, data processing.

STRUCTURAL FLIGHT MEASUREMENT

INSTRUMENTATION: systems design, calibration and maintenance.

WEAPONS: fire control systems, ordnance, rocket sleds.

RADIO AND RADAR: communications, search radar, magnatometers ranging and sighting gear.

DYNAMICS: flutter, sound, vibration, autopilot and approach systems.

Brief resumé form at right is for your convenience in contacting Lockheed.

California Division

Lockheed

Lockheed Aircraft Corporation
Burbank, California

E. W. Des Lauriers, Dept. VA-4-3
Lockheed Aircraft Corporation
Burbank, California

Name _____

Field of engineering _____

Home Address _____

Home Phone _____

Where employed _____

Engineers whose minds travel 7 miles per second*

find a rewarding future in rocketry at

REACTION MOTORS

Here are futures not bounded by the narrow limits of specialization or regimented production. At Reaction Motors, YOU are the engineer.

The problems provoked by man's determination to conquer time and space, to establish service satellites, to master the force of gravity and to develop precision in rockets will challenge your creative abilities. And the solutions add immeasurably to your professional stature.

Here at RMI you have at your disposal the tremendous research facilities and the accumulated technical skill gathered through 14 pioneering years of rocket research and development. All the important speed and altitude records for planes and single stage rockets are held by aircraft or missiles powered by engines developed by Reaction Motors.

If you ARE an engineer whose mind travels 7 miles per second, you'll reap a richer harvest at RMI. And you'll enjoy working in a completely equipped, brand new four million dollar plant in the heart of New Jersey's lake and mountain resort area, just 50 minutes from New York City.

We Have Immediate Openings For Men With Experience or Training In The Following Fields:

- Stress Analysts—Aircraft Engines or Airframes
- Environmental Testing of Components
- Aircraft Power Plant Installation
- General Project Engineering Work
- Engine Controls and Controls Systems
- Design of Airframe or Aircraft Engine-Type Parts
- Servo-Mechanisms
- Solid Propellant Grain Design for Seat Catapult Ejection Systems
- Thrust Chamber and Injector Design and Combustion Stability
- Design and Development of Hydraulic, Pneumatic and Mechanical Components and System Synthesis
- Analysis and Consultation on Rocket Engines and Power Plant Systems
- Formulation of Control System Problems, Computer Set-Up and Solution Analysis
- Rotating Machinery Design and Consultation
- Rocket Engine Testing and Instrumentation
- Internal Combustion for Jet or Rocket Engine Applications
- Preliminary Design or Proposal Experience in Aircraft Power Plant Field

RMI

REACTION MOTORS, INC.

"First in Rocket Power"

FORD ROAD DENVILLE, N. J.

AFFILIATED WITH THE OLIN MATHIESON CHEMICAL CORP.

Send Complete Resume Including Experience & Salary Requirements to Employment Manager

*Earth's Escape Velocity

ENGINEERS

Our South Charleston, West Virginia chemical plant has openings for Mechanical, Electrical or Chemical Engineers to fill the following positions:

SENIOR MAINTENANCE ENGINEER with considerable supervisory experience in chemical plant maintenance work. Must be familiar with up-to-date planning and scheduling methods.

MAINTENANCE ENGINEER with up to five years' experience in maintenance work to set up preventative maintenance procedures, redesign equipment where necessary and give technical assistance in maintenance procedures.

STEAM AND POWER ENGINEERS with up to 15 years' supervisory and/or staff experience in steam and power generation. Two positions are open.

PROJECT ENGINEERS with up to ten years' experience in mechanical and process design required for overall technical supervision of construction projects. Involves supervision from the preparation of engineering drawings to the final completion of a field installation.

This plant produces chlorine, caustic soda, carbon disulphide and a number of related inorganic and organic chemicals.

Please send resume and salary requirements to:

WESTVACO CHLOR-ALKALI DIVISION FOOD MACHINERY & CHEMICAL CORP.

Drawer 8127
South Charleston, West Virginia
Attention: Department 6

ENGINEERS

The APPLIED PHYSICS LABORATORY OF THE JOHNS HOPKINS UNIVERSITY offers an exceptional opportunity for professional advancement in a well-established laboratory with a reputation for the encouragement of individual responsibility and self-direction.

Our program of

GUIDED MISSILE DEVELOPMENT

provides such an opportunity for men qualified in:

SERVO MECHANISMS
MISSILE SYSTEMS DEVELOPMENT
HYDRAULIC CONTROL SYSTEMS
MECHANICAL DESIGN AND LAYOUT OF MISSILE COMPONENTS
INTERNAL AERODYNAMICS AND PROPULSION
MACHINE SHOP LIAISON AND PRODUCTION
STRESS ANALYSIS

Please send your resume to: Professional Staff Appointments

APPLIED PHYSICS LABORATORY THE JOHNS HOPKINS UNIVERSITY

8607 Georgia Avenue
Silver Spring, Maryland

MECHANICAL ENGINEERS
for
LIQUID NITROGEN APPLICATION DEVELOPMENT

We have unusual openings in application development on liquid nitrogen and other products and processes. Recent graduates or men with up to five years' experience in heat transfer, refrigeration, or low temperature are desired. These openings have high potential for men with imagination and creative ability. Bachelors or Masters Graduates.

Send resume of educational background (include approximate academic standing) and work experience to:

LINDE AIR PRODUCTS COMPANY
a division of
Union Carbide and Carbon Corporation
P. O. Box 44
Tonawanda, New York
Attention: Mr. Paul I. Emch
Refer to Ad: ME LN

ATOMIC ENERGY NEEDS YOUR TALENT

ALCO PRODUCTS, INC., wants additional competent Mechanical Engineers for nuclear power development. The potentialities of this growing field are limitless. YOU can help it grow! YOU can grow with it!

Typical positions available are:

MECHANICAL DESIGN ENGINEER

Experience Required: Minimum of 10 years including design and test of complex mechanisms and mechanical structures.

ASSISTANT PROJECT ENGINEER

Experience Required: 2 to 5 years' design or test of mechanical components.

JUNIOR ENGINEER

Experience Required: None. Also needed are several Mechanical Designers and Draftsmen.

IF INTERESTED please forward detailed resume and salary requirements to:

G. Y. Taylor, Manager
Employee Services Dept.
ALCO PRODUCTS, INC.
Schenectady 5, N. Y.

All replies kept confidential.

Want to get off the treadmill?

Then, you may be interested in knowing why I'm with

MOTOROLA IN PHOENIX

THIS IS A NEW FRONTIER insofar as the electronics industry is concerned. But it's big . . . and it's growing.

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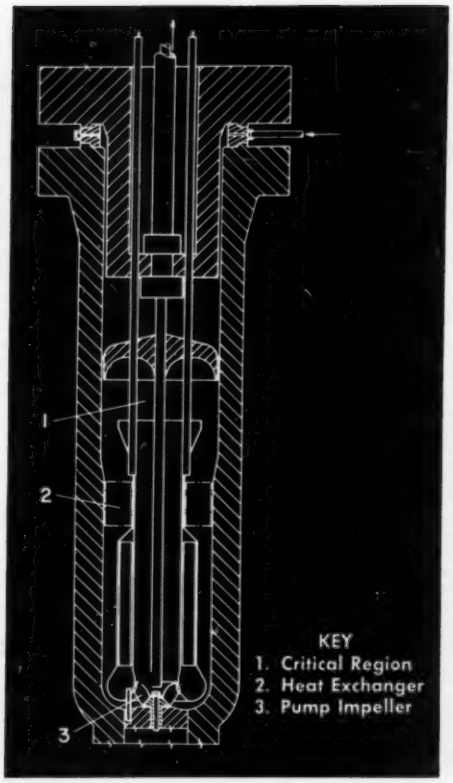

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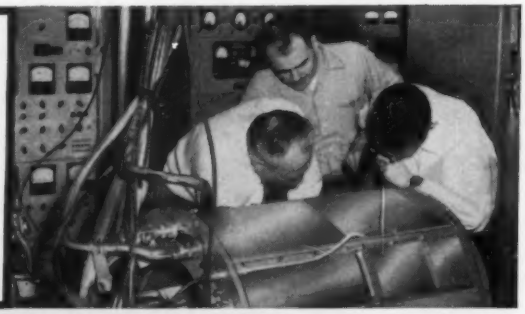

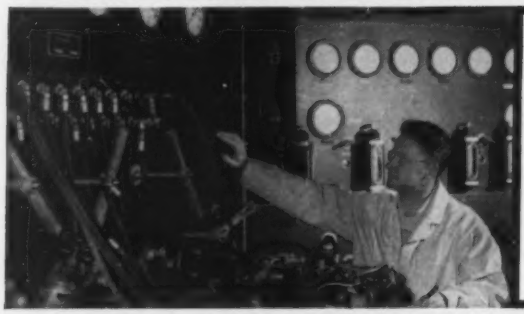

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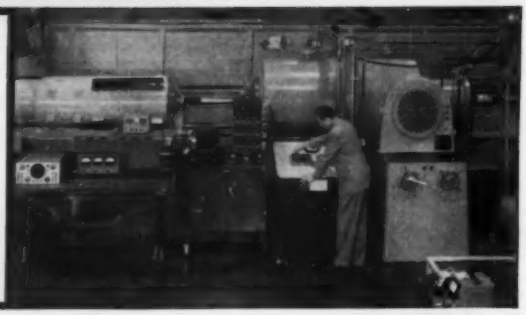

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Index to CLASSIFIED ADVERTISERS

AC Spark Plug Electronic Div., General Motors Corp. ... 148
Air Products, Inc. ... 141
Alco Products, Inc. ... 155
American Air Filter Co. ... 161
Arabian American Oil Co. ... 146
Avco Mfg. Corp. ... 138
Beckman Instruments, Inc. ... 158
Bendix Products Div.—Missiles ... 160
Boeing Airplane Co. ... 94
Chemstrand Corp. ... 49
Chrysler Corp. ... 145
Convair, Div. of General Dynamics Corp. ... 73, 100
duPont, deNemours, E. I. & Co. ... 152, 159
Electric Boat Div., General Dynamics Corp. ... 148
Esso Research & Engrg. Co. ... 142, 150
Experiment, Inc. ... 141
Fairchild Engine & Airplane Corp. ... 65
Farnsworth Electronics Co. ... 156
Garrett Corp.
AiResearch Mfg. Div. ... 128
Rex Div. ... 72
General Electric Co. ... 146, 150
General Motors Corp. ... 150
Grumman Aircraft Engineering Corp. ... 79
Gulf Research & Development Co. ... 158
Hughes Research & Development Corp. ... 68
Johns Hopkins University ... 154
Kearfott Co. ... 150
Lockheed Aircraft Corp. ... 153
Los Alamos Scientific Laboratory ... 157
Martin Co. ... 44, 85
Melpar, Inc., Sub. of Westinghouse Air Brake Co. ... 54
Motorola Research Laboratory ... 155
National Cash Register Co. ... 149
Northrop Aircraft, Inc. ... 48
North American Aviation, Inc. ... 98, 108, 124
Olin Mathieson Chemical Corp. ... 144
Pangborn Corp. ... 128
Pennsylvania State University ... 161
Phillips Petroleum Co. ... 144
Pratt & Whitney, Div. United Aircraft ... 52, 77
Radio Corp. of America ... 151, 152
Ramo-Wooldridge Co. ... 143
Reaction Motors, Inc. ... 154
Remington Rand Univac Div. Sperry Rand Corp. ... 90, 91
Republic Aviation Corp. ... 147
Sandia Corp. ... 66
Sperry Products, Inc. ... 80
Titeflex, Inc. ... 161
Westinghouse Bettis Plant ... 106
Westvaco Chlor-Alkali Div. Food Machinery & Chemical Corp. ... 154

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MECHANICAL ENGINEERING
February, 1956 CARD INDEX Vol. 78, No. 2

Developments in Instrumentation, Petrochemical Industry, R. G. Marvin, W. L. Stuart, G. W. Lunsford, E. E. Ludwig ... 132
How to Improve Profits, K. L. Block ... 135
Process Control by End-Point Analysis, S. M. Rock and Jack Walker ... 137
Field-Testing a Reversible Pump-Turbine, F. E. Jaski ... 141
Consumable-Insert Technique, Pipe Welding, R. D. Thomas, Jr. ... 145
Some Major Findings of the Hoover Commission, S. C. Hollister ... 150
A Role for Student Professional and Honorary Societies in Engineering Education, R. C. Dean, Jr. ... 154
Editorial ... 131
Briefing the Record ... 156
European Survey ... 168
ASME Technical Digest ... 170
Comments on Papers ... 180
Reviews of Books ... 182
ASME Boiler and Pressure Vessel Code ... 185
ASME News ... 188

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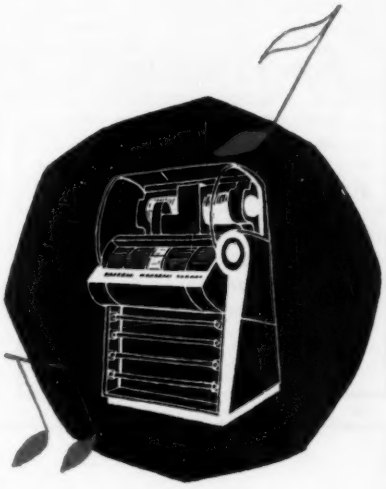

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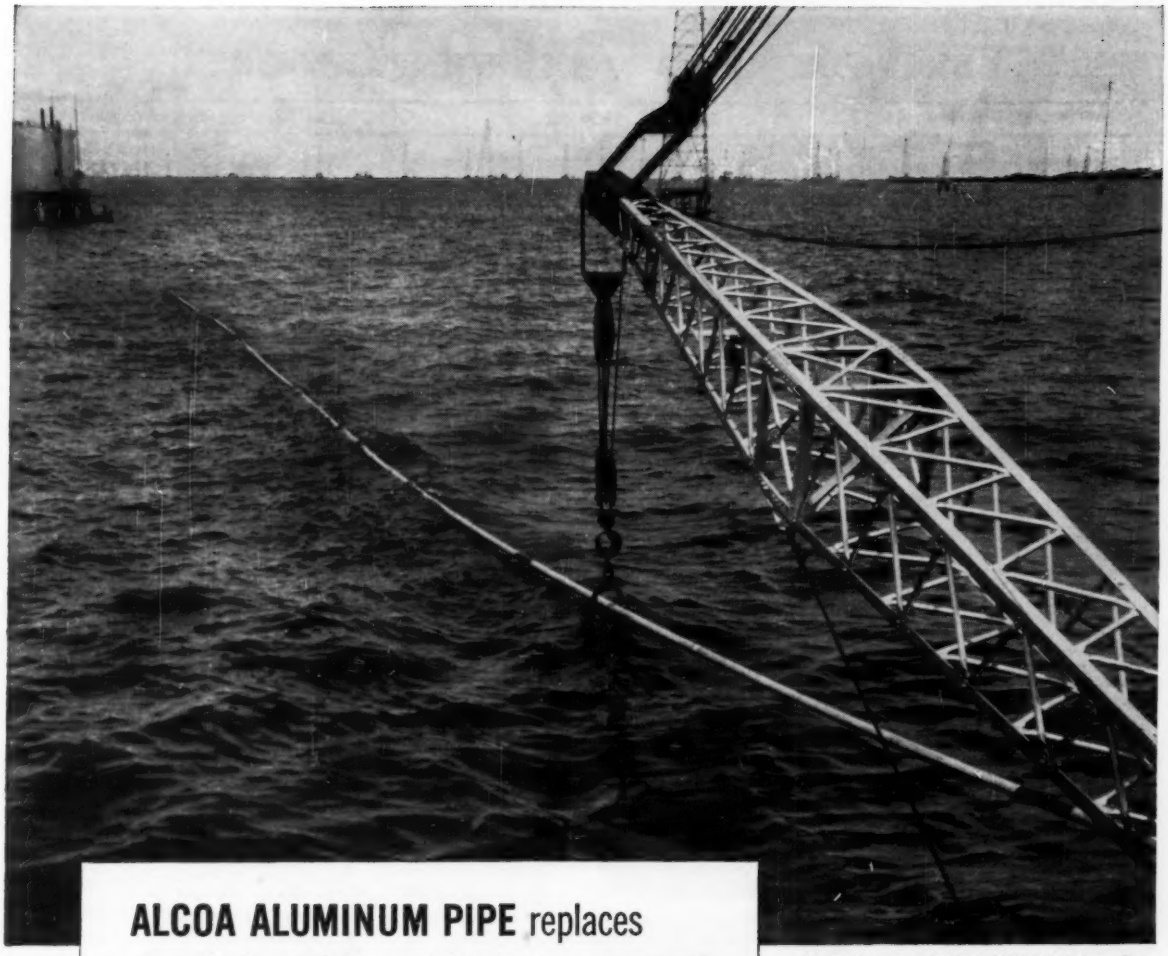

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Index To Advertisers

Acushnet Process Co. 83
*Aldrich Pump Co. 109
Aluminum Co. of America 165
*American Blower Corp 122
*American Pulverizer Co. 70
ASME Publications 75, 120, 133
Mechanical Catalog 116
Atlas Chain & Mfg. Co. 168

*Babcock & Wilcox Co. 2nd Cover
Barco Mfg. Co. 62
Bigelow-Liptak Corp 118
*Blaw-Knox Co.
Grating Dept 42
Bruning, Charles, Co. 28, 137
Brush Electronics Co. 101
Buck Mfg. Co. 25
Byers, A. M., Co. 129
*Byron Jackson Div.
Borg-Warner Corp 29

*Cash, A. W., Co. 115
Chace, W. M., Co. 50
*Chain Belt Co. 17, 18
Chapman Valve Mfg. Co. 16
Chicago Rawhide Mfg. Co. 95
Cincinnati Gear Co. 58
Clarage Fan Co. 4
*Cochrane Corp 89
*Columbia-Geneva Steel Div. 6, 7, 92, 93, 97
*Combustion Engineering (Inc.) 27
Cone Drive Gears Div.
Michigan Tool Co. 51
Coxhead, Ralph C., Corp 84
Cratex Co. 79

Denison Engineering Co. 105
*Diamond Power Specialty Corp 107
Dudek & Bock Spring Mfg. Co. 83

Eaton Mfg. Co. 33
*Elastic Stop Nut Corp. of America 61
Electrofilm (Inc.) 130

*Falk Corp 131
Ford Instrument Co.
Div. Sperry Rand Corp 126
Formica Co. 15
*Foxboro Co. 86, 87
Frick Co. 72
Fulton Sylphon Div.
Robertshaw-Fulton Controls Co. 21

*Gear Specialties (Inc.) 2
General Electric Co. 99
*Golden-Anderson Valve Specialty Co. 74
*Grinnell Co. 5

Hagan Corp 30
Hamilton Mfg. Co. 167

The asterisk indicates that firm also has product catalog in the 1956 Mechanical Catalog.

Hathaway Instrument Co.
Sub. Hamilton Watch Co. 54
*Hyatt Bearings Div.
General Motors Corp. 8, 9

*Illinois Gear & Machine Co. 39
International Nickel Co. 34

Jenkins Bros. 40
Johnson, Carlyle, Machine Co. 53

Kennametal (Inc.) 45
Kunkle Valve Co. 84

Lincoln Electric Co. 75
Linear (Inc.) 24
*Link Belt Co. 140
Lunkenheimer Co. 3rd Cover

Mammoth Furnace Co. 135
Mansel Div.
Houdaille Industries (Inc.) 76
*Mercoid Corp 60
Meriam Instrument Co. 57
Miniature Precision Bearings (Inc.) 74

Nagle Pumps (Inc.) 64
National Pneumatic Co.
Holtser-Cabot Motor Div. 58
New Departure Div.
General Motors Corp 1
Niagara Blower Co. 134
Nice Ball Bearing Co. 135
*Northern Blower Co. 63
Nugent, Wm. W. & Co. 46

*Oilgear Co. 123

*Pangborn Corp 43
Parker White Metal Co. 32
Peerless Electric Co. 47
Philadelphia Gear Works 12, 57
Pittsburgh Lectrodryer Corp 114
*Posey Iron Works 132
Powell, William, Co. 26

Racine Hydraulics & Machinery Co. 37
Raybestos-Manhattan (Inc.)
Packing Div. 69
Manhattan Rubber Div. 22
Read Standard Corp. 55
Reliance Gauge Column Co. 67
Republic Mfg. Co. 130
Revere Copper & Brass (Inc.) 31
Ric-Wil (Inc.) 125
Robertshaw-Fulton Controls Co.
Div. Fulton Sylphon 21
Rockford Clutch Div.
Borg-Warner Corp 81
Ross Heat Exchanger Div.
American-Standard 20
Rust-Oleum Corp 113
Ruthman Machinery Co. 70

*Southwest Products Co. 132
Springfield Boiler Co. 23
Stephens-Adamson Mfg. Co. 133
*Stewart, F. W. Corp.
Sub. of S. S. White Corp. 132
Stewart-Warner Corp.
Alemite Dept. 19
*Struthers Wells Corp.
Div. Titusville Iron Works Co. 71
Sturtevant, P. A., Co. 74
*Synchro-Start Products (Inc.) 135
*Syntron Co. 134

*Taylor Instrument Cos. 136
*Tennessee Coal & Iron Div. 6, 7, 92, 93, 97
*Terry Steam Turbine Co. 112
Thomas Flexible Coupling Co. 60
*Timken Roller Bearing Co. 4th Cover
*Titusville Iron Works Co.
Div. of Struthers Wells Corp 71
*Tube Turns 103, 104

*Union Iron Works 14
Union Spring & Mfg. Co. 78
United States Graphite Co.
Div. Wickes Corp 10, 11, 163
*United States Steel Corp 6, 7, 92, 93, 97
*United States Steel Export Co. 6, 7, 92, 93, 97

Vickers (Inc.)
Div. Sperry Rand Corp 111
Virginia Gear & Machine Corp 12, 57
*Vogt, Henry, Machine Co. 119

Waldes Kohinoor (Inc.) 139
Walworth Co. 3
*Watson Stillman Press Div.,
Farrel-Birmingham Co. 127
Wiegand, Edwin L., Co. 82
Wiley, John & Sons 130
Williams Gauge Co. 59
*Wolverine Tube Div.
Calumet & Hecla (Inc.) 121

*Yarnall-Waring Co. 35
Yoder Co. 117

*Zallea Brothers 13

CONSULTING SERVICE . . . Page 164

Black & Veatch
Electrical Testing Labs.
Gilbert Associates (Inc.)
Harza Engineering Co.
Jackson & Moreland
Kellogg, M. W., Co.
Kendall, George H.
Kuljian Corp.
Loftus, Peter F. Corp.
Lummus Co.
Mast Development Co.
National Weld Testing Bureau
Peacock Corp.
Polachek, Z. H.
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Sargent & Lundy
Sirrine, J. E., Co.
Stanley Engineering Co.

Advertisers in previous 1956 issues but not in this issue

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*Air Preheater Corp.
Ajax Flexible Coupling Co.
All American Tool & Mfg. Co.
*Allegheny Ludlum Steel Corp.
Allen-Bradley Co.
*American Brass Co.
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*Detroit Stoker Co.
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DuMont, Allen B., Labs. (Inc.)

Edward Valves (Inc.)
Sub. Rockwell Mfg. Co.
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W-S Fittings Div.
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Reliance Electric & Engrg. Co.
*Republic Flow Meters Co.
Research-Cottrell (Inc.)
*Rockwell Mfg. Co.
Nordstrom Valve Div.
Roots-Connersville Blower Div. Dresser Industries (Inc.)

Sanborn Co.
Snap-Tite (Inc.)
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*Taylor Forge & Pipe Works
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Vard (Inc.)
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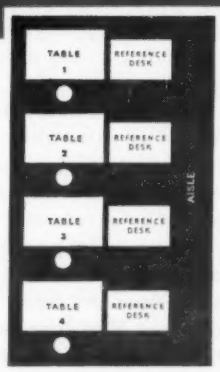
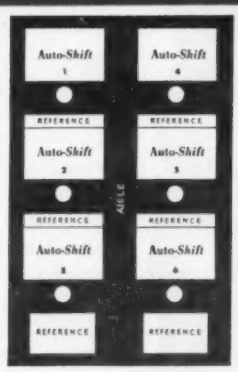


4 men work at standard tables and desks in about 250 square feet



6 men work at Auto-Shifts in approximately same area

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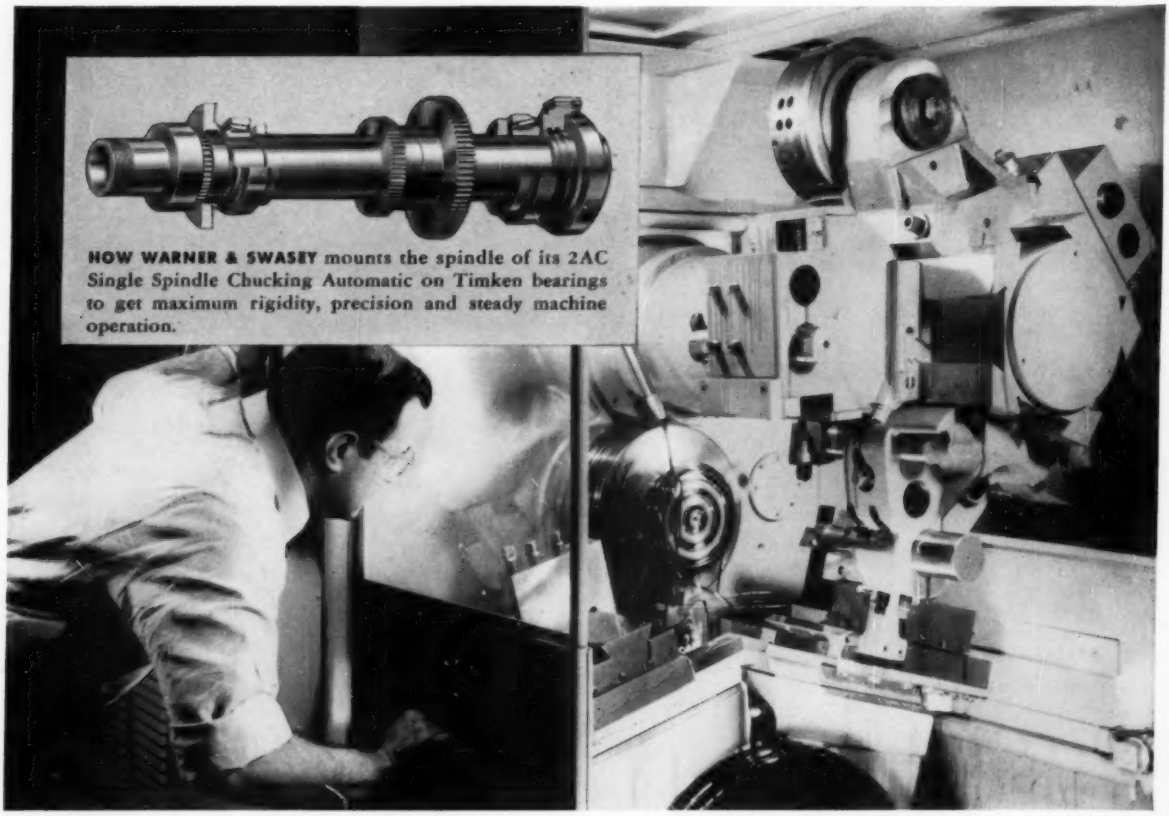
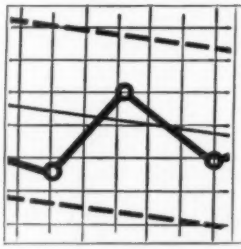


HOW WARNER & SWASEY mounts the spindle of its 2AC Single Spindle Chucking Automatic on Timken bearings to get maximum rigidity, precision and steady machine operation.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

TAPERED ROLLER BEARINGS



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